

A History of Medical Technology in Post-Colonial India:  
The Development of Technology in Medicine from 1947 to 1991.

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**Abstract**

Over the past 60 years, India has undergone immense political, economic, and social changes, which have led to its emergence as a global economic power and regional military power. During this period, the population has surged, growing from 233 million to 1.2 billion people, making India the second most populous nation in the world. In the course of this change, there have been key indicators of medical progress, such as rising life expectancy and a falling infant mortality rate. Another striking indicator, specifically in the area of medical technology, is the fact that India in 2006 was a net exporter of HIV medications to dozens of countries around the globe, earning a reputation as the pharmacist of the developing world. Although many books and papers have been written about the emergence of the country's economy and military, little has been written on how it has been able to achieve its leadership in medical technology.

This thesis, 'A History of Medical Technology in Postcolonial India: 1947—1991', is the first major study examining the development of medical technology in India in the period directly following colonial rule. The period covered in this research is crucial because it highlights the evolution and impact of medical technology in postcolonial India, leading up to, but excluding, the free-market reforms enacted by the Indian government in 1991. This thesis will also illustrate the impact diffusion had on the evolution of medical technology.

Most importantly, this thesis introduces a new concept appropriate to understanding India's trajectory in this period: the medical technology complex. It will be shown that this complex consists of different groups working toward an aligned objective. It is not the point of this thesis to characterize the medical technology complex in a positive light or a negative one. Its primary concern is to demonstrate through historical evidence that this construct grew throughout the twentieth century and still exists today.

## Long abstract

Over the past 60 years, postcolonial India has undergone immense political, economic, and social changes, which have led to its emergence as a global economic power and regional military power. During this period, the population has surged, growing from 233 million to 1.2 billion people, making India the second most populous nation in the world. In the course of this change, there have been key indicators of medical progress, such as rising life expectancy and a falling infant mortality rate. Another striking indicator, specific to the area of medical technology, is the fact that India in 2006 was a net exporter of HIV medications to dozens of countries around the globe, earning a reputation as the pharmacist of the developing world. Although many books and papers have been written about the emergence of the country's economy and military, little has been written on how it has been able to achieve its leadership in medical technology.

At a time when air travel has produced a global healthcare network connected, for example, by a 15-hour flight from New York to New Delhi, and global disease prevention is no longer a luxury but a necessity, a sharper understanding of the positions and policies relating to the technology and medicine of this emerging super power is required. It is hoped that future investigation in this vital area will be enhanced by the work undertaken in this thesis.

This thesis, 'A History of Medical Technology in Postcolonial India: 1947—1991', is the first major study examining the development of medical technology in India in the period directly following colonial rule. The period covered in this research is crucial because it highlights the evolution and impact of medical technology in postcolonial India, leading up to, but excluding, the free-market reforms enacted by the Indian government in 1991. This thesis will also illustrate the impact diffusion had on the evolution of medical technology.

Most importantly, this thesis will introduce a new concept that enables us better to understand the development taking place in India in this period: the medical technology complex. It will be shown that the medical technology complex consists of different groups working toward an aligned objective. It is not the point of this thesis to characterize the medical technology complex in a positive light or negative one. Its primary concern is to demonstrate through historical evidence that this construct grew throughout the twentieth century and still exists today.

Over the past two decades, historians such as Mark Harrison and David Arnold have examined the history of medicine under colonial rule. Their research has demonstrated the importance of medical technology, including devices and chemical innovations like vaccines. Despite the positive role of technologies such as smallpox vaccinations and water sanitation tools on India's public health system, their impact has been uneven due to religious strictures on purity, as well as suspicions that medical technology has been used as a means for the government to gain control local of populations. Local economic circumstances have also been crucial to the success or failure of medical interventions, no matter how one chooses to measure them.

This thesis will begin by discussing the current state of medical technology in India, defining relevant terms, and evaluating the diffusion of medical technology. Chapter 1 will begin with a literature review of the relevant literature for the history of life sciences and medical technology in India as well as the theoretical foundations of the medical technology complex (MTC). Chapter 2 will continue with an examination of India immediately before independence, explaining that India was, at this time, comprised two vastly different countries. One was mired in poverty and hunger, whilst the other consisted of small numbers of brilliant scientists,

ambitious entrepreneurs, world class biomedical engineers, and creative innovators. Then, the state of healthcare, medical education, natural resources, and medical technology on August 15, 1947 will be examined. Chapter 3 will concentrate on India's journey through post-war, post-colonial, and post-partition chaos during 1947 to 1951. The chapter will also consider the development of the All Indian Medical Institute and the influence of missionaries in India during this time. Chapter 4 focuses on India's development during 1952 to 1963, in particular the roles of international aid to India and the Cold War. Chapter 5 begins with a general analysis of India during the period 1964–1972, i.e. the 3<sup>rd</sup> and 4<sup>th</sup> five-year plans, international aid, and increased emphasis on education. Then, the Patents Act of 1970 and its impact on India's future is discussed.

Chapter 6 presents the start of tremendous growth and advancement in India that was enabled by the Patents Act of 1970. First, the factors that enabled India to develop its medical technology complex during 1973 to 1984, such as an English-speaking labour market and international investment, will be examined. India also began to develop medical education facilities and training. Chapter 6 will also discuss the eradication of smallpox in India and globally. Finally, the various theories discussed in the Introduction on the diffusion of Western science and innovations will be analysed and applied to the eradication of smallpox. Chapter 7 will examine the onset of economic liberalization during 1985 to 1991 and its effect on medical technology in India. Chapter 7 will also discuss the fall of the Soviet Union and how international aid continued to help India grow its medical technology complex. Finally, the Conclusion will summarize India's development from 1947 to 1991. The Conclusion will also examine India post-1991 by elaborating on how public policy and corporate planners in emerging economies can learn from the success of the Indian pharmaceutical and medical

technology industry. By the end of this work, the reader should have gained a new perspective on the importance of the development of medical technology in India from both the public health and geopolitical standpoints.

# Acknowledgements

Being familiar with the modern day medical technology complex, and having been well travelled throughout India, I sought to answer the question of how a country that was almost entirely bereft of the means to develop, produce, or distribute medical technologies in 1947 could emerge as one of the world's leading suppliers in the areas of medicines and medical devices, software, and supplies. Answering this question is the primary aim of this thesis.

This work would not have been possible without the help of numerous people from around the world. Above all, I am grateful for the guidance and support of my supervisor, Professor Mark Harrison, who inspired me with the first readings of his work. His understanding of where my research might lead, and his consistent responsiveness in providing insight, guidance, and direction was critical. The Wellcome Unit, particularly Belinda Michaelides, with her assistance and encouragement, also made this effort manageable. There are dozens of archivists who provided countless hours of support and feedback to track down the boxes, files, and folders most applicable for this effort. In particular, I need to thank the archivists at the National Archives of India, Bodleian Library at Oxford University, the Wellcome Library in London, and the Eisenhower Presidential Library. My research was also aided by interviews I conducted with people who had primary experience of medical technology in India during this period. I would like to thank Dr. M.P. Gupta, Dr. Gerald Henderson, and Professor Yadav for taking time to share their personal experiences of medicine in India. In addition, thanks are due to Waveney Golbourne, Simon Taylor, and Joann Tsempelis for their support and discussion at all hours of the day. Finally, I am particularly thankful to my wonderful parents, beautiful wife and two daughters. Their support never wavered during this incredible journey.

- S.W. Kachnowski, New York, NY

## List of abbreviations and acronyms

AIIMS	All India Institute of Medical Sciences
CDC	Centers for Disease Control and Prevention
CIPLA	Chemical, Industrial and Pharmaceutical Laboratories
CIPRO	Ciprofloxacin
CSIR	Council of Scientific and Industrial Research
CLA	Contract Labour (Regulation and Abolition) Act of 1970
ESIS	Employees State Insurance Scheme
GDP	Gross Domestic Product
GIC	General Insurance Corporation
IDRA	Industries Development and Regulation Act
IPR	Industrial Policy Resolution
IRCS	Indian Red Cross Society
ITT	Indian Institute of Technology
IDMA	Indian Drug Manufacturers Association
IMF	International Monetary Fund
LDCs	Less Developed Countries
MRI	Magnetic Resonance Imaging
NTTCs	National Teachers Training Centres
OECD	Organisation for Economic Co-operation and Development
OxFam	Oxford Committee for Famine Relief
RF	Rockefeller Foundation
RGCB	Rajiv Gandhi Centre for Biotechnology
RSS	Rashtriya Swayamsevak Sangh
SPG	Society for the Propagation of the Gospel in Foreign Parts
TRIPS	Trade Related Aspects of Intellectual Property Rights
U.S.	United States
UNFPA	United Nations Fund for Population Activities
USAID	United States Agency for International Development
USSR	Union of Soviet Socialist Republics
UDHR	Universal Declaration of Human Rights
WHO	World Health Organization

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## Introduction

‘There is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new order of things. ... Whenever his enemies have the ability to attack the innovator, they do so with the passion of partisans, while the others defend him sluggishly, so that the innovator and his party alike are vulnerable.’

– Niccolo Machiavelli, *The Prince*<sup>1</sup>

Over the past 60 years, India has undergone immense political, economic, and social change, much of which has led to its emergence as a global economic and military power. Since India achieved independence from Great Britain in 1947, its population has surged from 233 million to 1.2 billion people, making India the second most populous nation in the world. India’s population growth has been accompanied by important indicators of medical progress, including growing life expectancy and reductions in infant mortality. To take two examples, the average life expectancy in India has increased from 33 years in 1947 to 63 years in 2006<sup>2</sup> and infant mortality rates fell from 146 deaths per thousand births in the 1950s to 80 at the start of the twenty-first century.<sup>3</sup> The marked progress in the quality of life of the average citizen of India has been driven by advances in the cost efficient development, production, and distribution of medical technology.<sup>4</sup>

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<sup>1</sup> N. Machiavelli, *The Prince*, trans. George Bull (London, 1961).

<sup>2</sup> World Health Organization, *World Health Statistics 2008* (Geneva: World Health Organization, 2008), p. 38.

<sup>3</sup> India Achievements and Challenges in Reducing Poverty, Report No.16483-IN, Document of the World Bank (27 May 1997). Accessed at [www.wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1997/05/27/000009265\\_3971104184304/Rendered/PDF/multi\\_page.pdf](http://www.wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1997/05/27/000009265_3971104184304/Rendered/PDF/multi_page.pdf).

<sup>4</sup> C. Papageorgiou, A. Savvides, and M. Zachariadis, ‘International Medical Technology Diffusion’, *Journal of International Economics*, 72 (2) (2007), p. 425.

## I. Framing the questions

Although medical technology was prevalent in India in the forms of devices, supplies, and medicines, the term itself was rarely used before the 1950s.<sup>5</sup> The lack of use of the word suggests that the Indian population was not focusing on healthcare or medical technology. As technology is used by the masses, new words and terms become part of a region's language. The first instance of the term appeared in a 1953 *Times of India* article about the growing role of medical technology in the newly independent economy.<sup>6</sup> The first sentence of the article, 'A Career In a Test Tube', printed on October 4, 1953 read, 'Imagine a girl in white eagerly studying a slide under a microscope.'<sup>7</sup> The term did not appear again in the 1950s, then appeared only twice during the 1960s, before its usage jumped substantially in the 1970s, when it was used 81 times.<sup>8</sup>

In its current state, India's medical technology industry is unrecognizable from that which existed in 1947. At the time of India's independence, the medical technology industry was barely a \$1 million USD enterprise.<sup>9</sup> By the end of 2010, it stood at roughly \$8 billion dollars.<sup>10</sup> Even after inflation is considered, that is still a large increase. India's current medical technology capacity includes the ability to meet 95 per cent of its pharmaceutical needs, as well as 50 per cent of domestic medical device needs.<sup>11</sup> As far as drugs are concerned, India ranks fourth globally in terms of volume by production and thirteenth in terms of overall monetary value.<sup>12</sup>

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<sup>5</sup> The Henry J. Kaiser Family Foundation, 'Snapshots: How Changes in Medical Technology Affect Health Care Costs', 2 March 2007. Accessed at [kff.org/health-costs/issue-brief/snapshots-how-changes-in-medical-technology-affect/](http://kff.org/health-costs/issue-brief/snapshots-how-changes-in-medical-technology-affect/).

<sup>6</sup> M. Motiwalla, 'A Career in a Test Tube', *Times of India*, 4 October 1953, A3.

<sup>7</sup> *ibid.*

<sup>8</sup> *Search results – News & newspapers – ProQuest for 'medical technology'* (2013). Accessed at <http://search.proquest.com>.

<sup>9</sup> M. Mazumdar, *Performance of Pharmaceutical Companies in India* (New York, 2013), p. 17.

<sup>10</sup> 'Competitiveness of the Indian Pharmaceutical Industry in the New Product Patent Regime' (New Delhi: Federation of Indian Chambers of Commerce and Industry, March 2005)

<sup>11</sup> *ibid.*, 'Medical devices: Context, Outcomes, and Future Actions' (Version 8 Geneva: World Health Organization, 1st Forum, April 2011).

<sup>12</sup> 'Competitiveness of the Indian Pharmaceutical Industry'.

India also produces nearly all of the drugs available to its own domestic market.<sup>13</sup> The life sciences market in the country includes 250 large manufacturers and around 8,000 small ones.<sup>14</sup> In 2006, India was a net exporter of HIV medications to dozens of countries around the world, earning a reputation as the pharmacist of the developing world.<sup>15</sup> India's medical technology educational structure trains students across the country at doctoral and Master of Science levels, as well as in Masters of Business Administration.<sup>16</sup>

Whilst its medical technology sector includes medical device, equipment, and supplies, the single largest area of the Indian healthcare industry is pharmaceuticals, which have helped India establish a position of global dominance in healthcare. This represents an unprecedented turnaround from its position nearly 70 years ago. In a 2007 United States International Trade Commission report entitled 'The Emergence of India's Pharmaceutical Industry and Implications for the U.S. Generic Drug Market', William Greene noted that India's pharmaceutical industry had developed from almost nothing to become '...one of the world's leading suppliers of generic drugs.' Greene's report describes how India's pharmaceutical companies positioned themselves to offer generic forms of pharmaceutical products, in the process capturing roughly 30 per cent of the U.S. generic market. According to Greene, one of the driving forces behind India's success in this field is the fact that production costs in India are 'among the lowest in the world, estimated to be 70 per cent less than the West.' He went on to characterize the pharmaceutical

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<sup>13</sup> W. Greene, 'The Emergence of India's Pharmaceutical Industry and Implications for the US Generic Drug Market' (Publication No. 2007-05-A) (Washington, DC: Office of Economics and U.S. International Trade Commission, 2007). Accessed 15 September 2013 at [www.usitc.gov](http://www.usitc.gov).

<sup>14</sup> B. Gouri, 'Competition Issues in the Generic Pharmaceuticals Industry in India', Speech outline given at the Competition of Commission India (New Delhi, 14 August 2010).

<sup>15</sup> Greene, 'The Emergence of India's Pharmaceutical Industry', p.1.

<sup>16</sup> *Annual Report 2011-12*. Government of India. New Delhi: Department of Pharmaceuticals, 2012. Accessed at <http://pharmaceuticals.gov.in>.

industry as one of the fastest growing segments of India's domestic economy, at nearly 14 per cent per annum from 2002-5.<sup>17</sup>

Another major component of India's medical technology complex is its medical devices. India's medical devices sector is in the world's top twenty and the country exports nearly 70 per cent of the medical devices it produces.<sup>18</sup> The term 'medical device' was not used to any degree until the mid-twentieth century.<sup>19</sup> The term first appeared in the *Times of India* in April 1940, when the newspaper reported a new television developed in the United States that provided a clearer screen, but whose picture would be interfered with through a medical device.<sup>20</sup> This device was called a 'diathermy machine', used predominantly in gynaecology to help reduce muscle pain through the creation of heat via electromagnetic waves.<sup>21</sup> The term medical device was used sparsely throughout the next fifty years up until the early part of the twenty-first century in popular press publications.<sup>22</sup>

Medical devices are here defined as healthcare technologies that are not medicines, vaccines, or clinical procedures.<sup>23</sup> This definition, provided by the World Health Organization (WHO), lays out the most internationally recognized concept of what medical devices encompass: anything from a rehabilitative device to a pacemaker or piece of gauze. Whilst India is not self-sufficient in the area of medical device manufacturing, it does supply roughly half of its own devices.<sup>24</sup> One reason why medical device development, manufacturing, and distribution has not progressed as quickly as the pharmaceutical sector is that most such devices are

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<sup>17</sup> Greene, 'The Emergence of India's Pharmaceutical Industry.'

<sup>18</sup> R. Paddock, 'Medical Device Regulatory Profile for India' (New Delhi: Office of Health and Consumer Goods, International Trade Commission, 2010). Accessed 18 September 2013 at <http://cdsco.nic.in>.

<sup>19</sup> *Search results – News & newspapers – ProQuest for 'medical device'* (2013). Accessed at <http://search.proquest.com>.

<sup>20</sup> 'New Television Advance: 605 Line Screen in USA', *Times of India*, 9 April 1940, p. 10.

<sup>21</sup> *ibid.*

<sup>22</sup> *Search results – News & newspapers – ProQuest for 'medical device.'*

<sup>23</sup> 'Medical Devices.'

<sup>24</sup> Paddock, 'Medical Device Regulatory Profile for India.'

improved upon or rendered obsolete in a matter of two to three years.<sup>25</sup> Added to religious concerns regarding the use of bovine hooves and hearts and the expensive nature of the devices themselves, there has been a significant reduction in the domestic growth of medical devices in India.<sup>26</sup> Finally, in contrast to India's drug companies, medical device companies have found it more difficult to build the production facilities required to manufacture new medical devices for a global market.

Indian medical device manufacturers are, however, starting to establish the same dominant global role that their pharmaceutical compatriots have enjoyed over the past 30 years. To take one especially revealing example India has begun mass producing portable electrocardiographs at the cost of \$500 USD versus \$5,000 USD in developed countries.<sup>27</sup> The Aravind Eye Care System, which is known for producing high-quality lenses for \$5 USD, also produces a multitude of other cost effective ophthalmic devices.<sup>28</sup> In view of this, it is hardly surprising that growth in India's medical device industry outpaced that of its pharmaceutical industry in 2012; the trend for smaller, cheaper devices reaching more patients across India and the world seems to be growing.<sup>29</sup>

This thesis, 'A History of Medical Technology in Postcolonial India, 1947-1991', is the first major study examining the development of medical technology in India in the period directly following colonial rule. Upon reading the extant literature on public health in India in both the colonial and post-colonial periods, it becomes clear that medical technology in colonial

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<sup>25</sup> M. N. Venkatchaliah. 'Globalised Discontent: Outsourcing Can Help Bridge Rich-Poor Divide', *Times of India*, 7 April 2004, p. 12.

<sup>26</sup> 'Local Production and Technology Transfer to Increase Access to Medical Devices' (Geneva: World Health Organization, 2012).

<sup>27</sup> *ibid.*

<sup>28</sup> *ibid.*

<sup>29</sup> M. Rosen, 'Global Medical Device Market outperforms Drug Market Growth' (Madison, WTN News, 2008). Accessed 10 July 2012 at <http://wistechnology.com/articles/4790/>.

India was scant and mostly non-indigenous.<sup>30</sup> Nevertheless, the medical technology that was in place had a major influence on the life of Indians living in the areas of India in which the colonial government enacted various medical interventions.<sup>31</sup> The research covered here highlights the evolution and impact of medical technology in postcolonial India, culminating in the free-market reforms enacted by the Indian government in 1991. This thesis also develops the concept of the medical technology complex (MTC) and discusses the impact the MTC had in India.

This work also includes a comprehensive, chapter-length literature review. The purpose of this review is to address the secondary texts that will allow the reader to grasp current thinking about the history of the Indian medical technology and life sciences industry, and provide an overview of the domestic demand to which the MTC has responded. Equally, the literature review will address theoretical material regarding social science models of innovation, particularly the National System of Innovation (NSI) literature, and distinguish the MTC from that material. It will begin to frame a series of questions that this work will attempt to address. Firstly, how did a country on the verge of collapse upon independence in 1947 manage to create a life science and medical technology industry that has become a global leader today? Secondly, why has India seen success in its medical technology industry whilst other industries have languished? Thirdly, what lessons for policy and corporate planning leaders, in both India and in the developing world, can be learned from this experience? This work will provide a wider context for these individuals.

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<sup>30</sup> Harrison, *Public Health in British India*, p. 89; Arnold, *Science, Technology and Medicine in Colonial India*, p. 87; D.R. Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism* (New York, 1988), p. 154; A. Porter, *Religion Versus Empire? British Protestant Missionaries and Overseas Expansion, 1700-1914* (Manchester, 2004).

<sup>31</sup> Harrison, *Public Health in British India*, p. 89.

## II. The Definitions of Development, Technology, and Complex

This work hinges upon detailed definitions of the key components of the title: development, technology, and complex. This section provides the definitions and the background of these terms so that the reader can comprehend how they have been treated in major works of historical research.

Historians have provided numerous definitions of the term ‘development’. In some works, it has represented the growth of a society at the cost of the environment.<sup>32</sup> In Gilbert Rist’s *The History of Development: From Western Origins to Global Faith*, the author elaborates on Durkheim’s conception of development to include any practices, profit or non-profit, oriented toward growth.<sup>33</sup> There are several other ways that the word ‘development’ can be defined. The term is often used in an economic context to denote industrial growth or the ‘enabling’ of a particular area.<sup>34</sup> Another, related meaning of the term has been associated with modernizing specific aspects of a local area, region, or nation, as in the field of ‘Development Studies’.<sup>35</sup> Other definitions include a more pejorative meaning with regards to the cultural and environmental toll that development can wreak on indigenous countries.<sup>36</sup> For the purposes of this work, development will include the economic growth and evolution of medical technology in India from 1947 to 1991.

Historians have also debated what the term ‘medical technology’ means and signifies. In its simplest form, the *Oxford English Dictionary* defines technology as ‘the application of scientific knowledge for practical purposes, especially in industry.’<sup>37</sup> In her 2010 article on the

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<sup>32</sup> D. Lehmann (ed.), *Development Theory: Four Critical Studies* (New York, 2011), p. 10.

<sup>33</sup> G. Rist, *The History of Development: From Western Origins to Global Faith* (London, 2002), p. 13.

<sup>34</sup> P. Bianchi and S. Labory, *International Handbook on Industrial Policy* (Northampton, 2008), p. 12.

<sup>35</sup> D. Seers, *The Meaning of Development* (New Delhi, 1969), p. 29.

<sup>36</sup> A. Escobar, *Encountering Development: The Making and Unmaking of the Third World* (Princeton, 2012), p. 121.

<sup>37</sup> Technology Def. 1. (n.d.), *Oxford Dictionary Online*. Accessed 11 September 2013 at [www.oxforddictionaries.com/defintion/technology](http://www.oxforddictionaries.com/defintion/technology).

famed institutional economist Clarence Ayres, Anne Mayhew defined technology as a ‘process involving both physical tools and a scientific method of reasoning, where science is understood to achieve cross-cultural explanatory power by virtue of technological validation.’<sup>38</sup> Headrick suggests that technology should be understood as more than just the ‘nuts and bolts stories of great inventors and famous engineers’; it also encompasses the connection that technology shares with the culture and the economy of a given society.<sup>39</sup> These definitions of technology are important in providing the core understanding of how technology has been applied to medicine.

For the purpose of this work, medical technology is defined as the tools and systems used to translate medical knowledge into practice, either in the clinic or in the field of public health; this definition extends beyond the drugs, devices, and supplies ordinarily used in medicine and public health, to encompass the larger culture and economy of Indian society. The tools can be any device, drug, or supplies that can be used to benefit medical care.<sup>40</sup> These include vaccines, antibiotics, and any other drugs or molecular interventions, as well as medical devices, eyeglasses, wheelchairs, pacemakers, glucometers, and heart and lung machines. Large instruments such as X-ray machines and MRIs are also considered medical technologies. Medical technology and its development, production, and ultimate delivery drives most of medicine and public health today; indeed, without access to these preventive, diagnostic, or surgical technological interventions, the ability of doctors to provide effective treatment in any location is severely hampered.<sup>41</sup> Thus it makes sense that as more medical technology became available in India over the course of the twentieth century, the term became more prevalent.

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<sup>38</sup> A. Mayhew, ‘Clarence Ayres, Technology, Pragmatism, and Progress’, *Cambridge Journal of Economics* 34 (2010), p. 213.

<sup>39</sup> Headrick, *The Tentacles of Progress*, p. 4.

<sup>40</sup> A.L. Greer, ‘Medical Technology: Assessment, Adoption, and Utilization’, *Journal of Medical Systems* 5 (1-2) (1981), pp. 129–45.

<sup>41</sup> D. Callahan, ‘Health Care Costs and Medical Technology’, The Hastings Center. Accessed at [www.thehastingscenter.org/Publications/BriefingBook/Detail.aspx?id=2178](http://www.thehastingscenter.org/Publications/BriefingBook/Detail.aspx?id=2178).

Although the term ‘medical technology complex’ has been used intermittently in the health studies literature over the last fifty years, it has not been clearly defined. Indeed, it has often been used to denote a series of physical structures and buildings providing medical technology within a larger healthcare campus, an inadequate and, for our purposes, misleading definition.<sup>42</sup> In a 1980 article entitled ‘The New Medical-Industrial Complex’, Arnold Relman, a professor of medicine at New York University, outlined the host of external forces converging on the field of medicine, including corporations working in various sectors of healthcare such as hospitals, pharmaceuticals, and insurance.<sup>43</sup> He went into great detail about challenges that emerged from within a for-profit corporate healthcare complex, especially the problems that physicians face when trying to overcome the financial influence of the new multi-billion dollar corporations that were beginning to exert a disproportionate influence on American medicine. However, the article focused almost exclusively on services rather than the technological entities involved in public health medicine. Relman also failed to address the diverse multitude of stakeholders involved in the actual complex of healthcare delivery, focusing instead on for-profit corporations.<sup>44</sup>

One key distinction between the medical technology complex and the new medical industrial complex lies in the stakeholders’ motives. The primary goal of the medical technology complex was – and remains – the improvement of healthcare across the world. Governments, foundations, corporations, and missions were striving to diagnose and cure morbidity through the use of predominantly Western medical technologies such as vaccinations, antibiotics, X-rays,

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<sup>42</sup> W.A. Hall, *Medical Complex Could Breathe Life into Newburgh’s West Street* (2000). Accessed at [www.recordonline.com](http://www.recordonline.com); *The Medical Technology Complex Building Project for a Hospital in Shanghai* (2013). Accessed at <http://en.topbm.com>; *German Chancellor Angela Merkel Opens B. Braun Production Facility in Vietnam* (2011). Accessed at [www.bbraunoem.com](http://www.bbraunoem.com).

<sup>43</sup> A.S. Relman, ‘The New Medical–Industrial Complex’, *New England Journal of Medicine*, 303 (17) (1980), pp. 963–70.

<sup>44</sup> *ibid.*

and other pharmaceuticals, devices, and drugs. The new medical industrial complex, on the other hand, had profit as its primary motivation. As Relman noted, the corporations in the United States that encompassed the new medical industrial complex had emerged from a predominantly non-profit driven healthcare system in the early-twentieth century into an overwhelmingly profit-driven healthcare system by the close of the century.<sup>45</sup>

In order to better understand the idea of a medical technology complex, it is helpful to examine a comparable historical example: the military industrial complex. On January 17, 1961, Dwight D. Eisenhower, the outgoing President of the United States of America, made an historic address to the American people.<sup>46</sup> He was coming to the end of four decades of public service, including a long and highly decorated military career, President of Columbia University, and two terms as U.S. President.<sup>47</sup> Despite, or perhaps because of, his rich history of military and public service, Eisenhower devoted much of his farewell address to warning of the dangers of what he referred to as America's 'military industrial complex,' which he defined as a 'permanent armament industry of vast proportions [...], a conjunction of immense military establishment and a large arms industry.' Eisenhower continued by cautioning that America 'must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military industrial complex.' A military man for much of his life, Eisenhower now suggested that the security for which the United States longed threatened the Constitutional principle 'that security and liberty may prosper together.'<sup>48</sup>

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<sup>45</sup> *ibid.*

<sup>46</sup> J.C. Hagerty, *Press Release Containing the Text of the Address*, Text of the address by President Eisenhower, broadcast and televised from his office in the White House. 17 January 1961. DDE's Papers as President, Speech Series (Box 38, Final TV Talk, 1). Eisenhower Presidential Library, Abilene, KS.

<sup>47</sup> J. Darby, *Dwight D. Eisenhower* (Minneapolis, 2004), p. 98.

<sup>48</sup> Hagerty, *Press Release Containing the Text of the Address*.

Further clarification of what Eisenhower meant by military industrial complex can be found in his exchange with Theodore Kennedy, a professor of American Thought and Language at Michigan State University.<sup>49</sup> Kennedy had enquired as to whether Eisenhower's concept of the military industrial complex could be traced back to the latter's experience heading the War Policies Commission in 1932.<sup>50</sup> Was there, asked Kennedy, 'any connection in your mind between your experience with the Commission's investigation of war profits and the caution you expressed in your farewell address as President regarding potential military-industrial relationships inimical to the nation's liberty?'<sup>51</sup> In his response, dated June 21, 1967, Eisenhower responded that his experiences on the Commission lead him to believe that though the United States did not want war, they had to contend with a military industrial complex in which 'so many sectors of our nation – defence forces, industry and political officials – were all influenced toward greater and greater armament production in time of peace.'<sup>52</sup> Key to the exchange was the scope that Eisenhower attributed to the complex, which moved from the military establishment to private industry, and then on to elected officials.

Eisenhower's speech laid the groundwork for the present work's conception of a complex: a vast yet unsystematic group of stakeholders acting in a substantially aligned fashion. There are, nevertheless, important differences between Eisenhower's characterization of a military-industrial complex and the medical technology complex. The term medical technology complex describes a broader version of organizational structure and incentives beyond that of a narrow 'industrial complex.' In this context, 'industrial' can be said to imply a single industry

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<sup>49</sup> D.D. Eisenhower, *Reply from Dwight D. Eisenhower to Professor Theodore R. Kennedy*. Letter to T. R. Kennedy. DDE's Post-Presidential Papers (21 June 1967) (1966 Principal File, Box 5, Business Economics, 6). Eisenhower Presidential Library, Abilene, KS.

<sup>50</sup> T. R. Kennedy, *Letter from Professor Theodore R. Kennedy to Dwight D. Eisenhower*. Letter to T. R. Kennedy. (13 June 1967) DDE's Post-Presidential Papers (1966 Principal File, Box 5, Business Economics, 6). Eisenhower Presidential Library, Abilene, KS. *ibid.*

<sup>51</sup> *ibid.*

<sup>52</sup> Eisenhower, *Reply from Dwight D. Eisenhower to Professor Theodore R. Kennedy*.

driven, above all, by profits. As this work will demonstrate, the medical technology complex, by contrast, consists of a complex network of actors, stakeholders, and institutions that operate in an uncoordinated fashion toward a similar goal. Many of these individuals and groups have emerged from beyond the industrial sphere: multi-lateral organizations, missionaries, charities, non-governmental organizations, and public health groups do not fall under the rubric of ‘industrial’, yet work hand in hand in the acquisition and distribution of various assets of medical technologies that are critical toward the overall management of population health around the world today.

Each power broker within the medical technology complex had its own distinct reasons for participating in the effort to improve India’s public healthcare environment. Missionaries hoped to expand their global influence by recruiting new church members in Christian-minority countries. For local governments, medical technology was a way to improve the lives of its citizens, as well as the wider economy. Corporations, in turn, were attracted to the expansion of markets and increase in profits. From the perspective of foreign governments, medical technology provided leverage over the recipient nation’s political future, whether free-market or communist. Finally, for foundations and other charitable organizations, many of which were aligned with or sponsored by foreign governments, the medical complex was a way to contribute to the development of an emerging nation whilst also occasionally influencing foreign relations. Whilst the stakeholders’ agendas were independent, their goals were broadly aligned: each attempted to improve the access, affordability, and quality of public health in the Indian subcontinent through the use of medical technologies that facilitated improvements in the wellbeing of the India populace.

The medical technology complex is thus defined as a group of highly varied organizations or stakeholders – whether multi-lateral agencies, foundations, religious organizations, non-profits, non-governmental organizations, government organizations, elected officials, and private corporations – acting to achieve a similar goal through various means, with many sub-agendas surrounding that objective. It is not merely devices and instruments that many might naturally associate with technology, but it also includes the above stakeholders involved in the funding, development, distribution, and on-going implementation of technologies. The actors involved in India’s medical technology complex had an overarching goal of improving the healthcare treatment and outcomes of tens of millions of Indian patients. Together, these individuals and organizations established themselves as a powerful force, not only in medicine and public health, but also, as we will see, international business and foreign policy as well. The medical technology complex, which first emerged as a disparate group of actors in colonial India, has since grown to become one of the largest segments of one of the world’s largest economies, second only to software. The aggregated group of actors in this arena have become critical in creating new levers for foreign policy that have yet to be studied, but will provide substantial material for future research.

### **III. Stakeholders in the Medical Technology Complex**

Now that the medical technology complex has been defined, it is important to focus on the stakeholders involved in the complex, as well as their motivation. The major stakeholders of the medical technology complex include governments, multilateral agencies, foundations, non-profit organizations, religious organizations, and corporations. All of these stakeholders have the goal of improving healthcare around the world, but their policies are often distinct. In the case of

governments, medical technology not only improves the healthcare of the nation, but also serves as a leverage point for influence or good will. For foundations like the Rockefeller Foundation and the Bill and Melinda Gates Foundation, medical technology furthers the aims of the funders and founders. The sustainability of many non-profit organizations also focuses on their ability to have an impact and relevance, which includes using medical technology to improve healthcare. The same is also true of religious organizations, whose funding was often tied to using medical technology to win influence and encourage converts. Finally, corporations are driven by profit and growth. Despite these disparate agendas, these entities helped to spread Western science, including medical technology. Within these stakeholders are included groups such as the government of India, the World Health Organization, CIPLA, the Rockefeller Foundation, the Society for the Propagation of Christ, and the Red Cross.

The involvement of governments is an important factor in medical technology in India, as can be seen by the geopolitical pressure applied throughout the first forty-five years of India's independence. In the polarized Cold War race for global influence, India's nonalignment policy led to enormous funding from both the West and the Soviet Union, which in turn helped to develop its medical technology manufacturing and diffusion. For example, the Soviet Union provided massive monetary assistance to set up pharmaceutical plants in India to maintain relations during the former's invasion of Afghanistan in the late 1970s and early 1980s.<sup>53</sup>

There were also clear political advantages for any Indian government looking to improve domestic healthcare through the development, production, distribution, and administering of medical technologies. At the local, state, or federal levels, governments were all interested in maintaining political power. However, the government was greatly hampered by the fact that

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<sup>53</sup> A. Mayer, 'The Soviet-Indian Alliance', *Tradecraft Review: Periodical of the Military National Security Service* (2012–13), p. 27. Accessed at [http://www.kbh.gov.hu/hu/letoltes/szsz/2013\\_2\\_spec.pdf#page=17](http://www.kbh.gov.hu/hu/letoltes/szsz/2013_2_spec.pdf#page=17).

public health programmes were viewed as less of a priority than building a new bridge or school, until the smallpox eradication campaign. Due to the devastation caused by smallpox and the international movement to end smallpox, the Indian government and other governments realized how important healthcare was to a nation. The Smallpox Eradication Programme not only eliminated smallpox, but also changed the world's view on healthcare.

The second major stakeholder in this mix was the not-for-profit organizations and/or multilateral agencies that have the improvement of healthcare access and quality as their core mission. These groups included the Red Cross, United Children's Emergency Fund, and the WOR. Such institutions attempted to improve healthcare through the use of medical technologies, and were at the forefront of many of India's healthcare programmes, often administering and implementing medical technology along the way. The history of the American Red Cross in India demonstrates the role of non-profit stakeholders in the international medical technology complex.<sup>54</sup> The Red Cross was one of many not-for-profit organizations operating in India as an almost supra-national body. The cornerstone of the various non-profit organizations operating in India since independence has been their philanthropic mission. As part of this effort, the Indian Red Cross had been actively involved in providing educational and medical aid to Indians since 1896.<sup>55</sup>

The third major stakeholder in the MTC was the corporations. Pharmaceutical companies, medical technology companies, and medical suppliers all aimed to increase the development, production, distribution, and administration of technology in order to increase profits and expand their international presence. However, their ultimate goal was the same as other elements of the MTC: to increase the diffusion of medical technologies around the world.

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<sup>54</sup> M.M. Jones, *The American Red Cross from Clara Barton to the New Deal* (Baltimore, 2013), p.63.

<sup>55</sup> C. Barton, *The Red Cross in Peace and War* (Washington D.C., 1910), p. 333.

A fourth stakeholder in the MTC was the family foundations and trusts established by philanthropists over the past century. This group of stakeholders included organizations such as the Wellcome Trust, the Ford Foundation, and the Rockefeller Foundation. These foundations have spent tens of millions of dollars each year improving the accessibility and quality of healthcare around the world. Many of these interventions to improve public health have included medical technologies. Whilst their goal is the development, production, distribution and administration of these technologies, their agenda is to meet requirements set forth by the founders of the foundation. For example, the Rockefeller Foundation implemented various funds to improve public health and thereby stabilize the world's newest and largest democracy. Whether it was for the establishment of the All-Indian Medical School or funding the school's laboratory and X-ray technology equipment, the Rockefeller Foundation was at the forefront of attempts to improve accessibility and quality of healthcare in India during the first half century of independence.

The last MTC stakeholder considered in this work are the medical missionaries, particularly the Society for the Propagation of the Gospel (SPG). In the pre-independence period, medical missionaries were a key constituency in bringing medical technology to India and ensuring its proper distribution and administration. Their mission hospitals were some of the most advanced medical institutions in newly independent India. As India evolved politically, the medical missionaries were also active in implementing medical technologies to improve family planning. The core of these religious groups' mission was to increase the numbers of participants in their congregations. Thus, they were a crucial part of the international medical technology complex and a key contributor to India's medical technology in the first fifty years of its independence.

Ultimately, the prioritization of these agendas, whether political or economic, led to the development and diffusion of the medical technology complex in India. The most striking example of the MTC at work was the eradication of smallpox. Following hundreds of millions of dollars of funding globally, and the efforts of hundreds of thousands of workers in India organized by the World Health Organization, one of the most deadly and deforming diseases in human history was eradicated from the country. At the heart of the transformational effort was the ability of the stakeholders to navigate the political and economic priorities of governments, corporations, and agencies.

With their growing presence in India, each set of organizations had its own agenda. The Indian medical technology industry was at the same time growing during this period. However, the move from recipient to provider took place in the era following the Patents Act of 1970. In the mid- and late-1970s, India began to see its exports of medical technology rise substantially. India's medical technology industry had become an indispensable component to the international medical technology complex, thereby completing a dramatic transformation.

#### **IV. Factors that Enabled the Growth of India's Medical Technology**

The following chapters will provide the background needed to understand how India grew its medical technology complex to the point at which a former colony could become one of the largest exporters of medical technology. A combination of tax policies, patent laws, and foreign policy manoeuvring allowed India to overcome significant obstacles to growth. In addition, India developed its medical education and an infrastructure for research and development, particularly clinical trials. It was also possessed of many of the natural resources necessary to develop medical technology, as well as a strong domestic market. Finally, India had an advanced

transportation network: its 67,247 kilometres of railroad track comprised the world's fourth largest network in 1930.<sup>56</sup>

One of the most important elements that enabled medical technology growth was a robust and innovative education system. Medical technologies, unlike many other technologies in consumer electronics or telecommunications, require a large number of technicians in order to implement their intervention. A particular case in point is vaccines. In India, vaccines were administered by hundreds of thousands of public health workers hundreds of times each week, all of whom were specially trained. India had a well-trained population of public health workers who could carry out these large campaigns for vaccination and thus supported the development and production of medical technologies in domestic markets. An educated population is also required to design, create, and test medical technologies. In the case of India, a vast amount of resources, and training, were required in order to build the constituent part of stainless steel, power plants, and clinical trials that were needed to eventually develop a substantial medical technology complex. Without this educated workforce, India could never have risen as quickly as it did to the point of medical technology leadership achieved in 1991.

Another crucial element is the resources native to a country. In India's case, the metallic elements required to create the alloys used in stainless steel were found in the soil itself, as well as the tens of millions of litres of fresh water that were needed for medicines. And the list could go on to include alcohol and other ingredients necessary to make devices, medicines, and supplies. As discussed in Chapter 2, India's natural resources proved to be an irreplaceable element in the growth of its medical technology complex over the first fifty years of independence.

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<sup>56</sup> D. Donaldson, *Railroads of the Raj: Estimating the Impact of Transportation Infrastructure* (No. w16487) (National Bureau of Economic Research, 2010), p. 8.

In addition, viable domestic and foreign markets are critical for the growth of medical technology. In India, the size of the domestic population created an easy return on investment formula for the government to rationalize funding self-sufficient vaccination plants as early as 1954.<sup>57</sup> This domestic market allowed India to develop medical technology production that could never have grown in smaller developing countries in Asia, Africa, or Latin America. Further, the emergence of India's market superiority had much to do with its ability to sell its products in the secondary markets of the Soviet Bloc countries and eventually the developing world. These foreign markets provided much needed capital for medical technology organizations in an often struggling Indian economy. Were it not for the presence of these external markets, much of the Indian medical technology complex would not exist today.

The ability to conduct research and development within the specific region or country is also required for the growth of medical technology. Looking at India's history, we can see that the infrastructure for research and development, particularly clinical trials, was critical in developing a domestic base for medical technology growth. An infrastructure, however slight, existed in pre-independence India under British rule. Then, with the growth of the research institutes throughout the 1950s, '60s, and '70s, a strong base for research and development in clinical trials through the rest of the twentieth century emerged. In addition, India benefitted from its relationships with the other Commonwealth nations, as well as the United States. Documents ranging from reports in the National Archives of India to grants funded and archived at the Rockefeller Foundation's Library demonstrate that scientists, physicians, and public health experts from India were tied to international research institutions. Connecting to these international groups and organizations provided both intellectual feedback on various data and

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<sup>57</sup> R. Parker, 'Soviet Aid for Pharmaceutical Plant Project: Indian Team Signs Pact in Moscow, 80 Million Rouble Credit Offered', *Times of India*, 30 May 1959, p. 1.

much needed funding when vaccines or devices were undergoing testing. Such competence in clinical research cannot be understated as an influence for medical technology diffusion.

The final element necessary for the growth of medical technology is transportation. One clear competitor advantage India had over many other nations was its extensive transportation system, a result of the fact that India was a wholesale exporter of goods for British economic concerns in India during the British Raj.<sup>58</sup> The rail system in India transported various materials and supplies required not only for the construction of the factories needed to produce pills, devices, and supplies, but also the distribution of those products to markets in India and abroad. India's railways, roadways, and seaways were further expanded upon by the first three of India's five-year plans and grew in the 1950s, '60s, and '70s. This transportation infrastructure underpinned India's long term growth in the development, production, and, crucially, distribution of medical technologies. India's transportation resources can be linked directly to its ability to diffuse/export medical technologies.

## **V. The Growth of Medical Technology and Its Impact**

The primary activity of the global healthcare system is the delivery of products created by a medical technology complex. The global healthcare system began coordinating efforts around disease eradication, vaccination, and surveillance in the years during and immediately after World War II, followed by specific interventions to improve healthcare accessibility, affordability, and quality.<sup>59</sup> These goals have been discussed extensively in the 65 or so years since the Universal Declaration of Human Rights (UDHR) expanded the global vision of

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<sup>58</sup> G. Das, *India Unbound* (London, 2002), p. 68.

<sup>59</sup> M. Harrison, *Medicine and Victory: British Military Medicine in the Second World War* (Oxford, 2004); R. Cooter, M. Harrison, and S. Sturdy (eds.), *Medicine and Modern Warfare* (Amsterdam, 1999), p. 157.

healthcare by establishing it as a human right.<sup>60</sup> Following the adoption of the Declaration in 1948, many global powers attempted to provide medical support to both nations recovering from the destruction of World War II and also developing nations around the world. In the wake of the UDHR, major institutions such as the World Health Organization<sup>61</sup> and United States Agency for International Development (USAID) were formed, joining the Oxford Committee for Famine Relief (Oxfam), which had been founded in 1942.<sup>62</sup> *Médecins sans Frontières* (Doctors Without Borders), another significant global health organization, was formed in 1971 after the Nigerian Civil War.<sup>63</sup> These institutions, as well as the Red Cross, United Way, and the Salvation Army, emerged into a more or less coordinated force for the improvement of human rights, disease prevention, medicine, and medical delivery around the world in the second half of the twentieth century.

At a time in which air travel has produced a global healthcare network connected by a 15-hour flight from New York to New Delhi, a more accurate understanding of the positions and policies relating to the technology and medicine of this emerging power is necessary.<sup>64</sup> The growth of the medical technology complex in India throughout the twentieth century was not only of material benefit to India's vast population, but also became a crucial tool in improving India's geopolitical role in a Cold War world. The way in which India – understood here as both a sovereign nation and a series of independent corporate actors – leveraged its medical technology complex changed how public health and medicine are administered around the world.

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<sup>60</sup> 'Universal Declaration of Human Rights', Resolution adopted by the General Assembly of the United Nations, 10.12 (1948).

<sup>61</sup> 'Global Strategy for Infant and Young Child Feeding', (World Health Organization & UNICEF, 2003).

<sup>62</sup> It was founded 'to support the Greek population with grain ships during the Second World War. N. Brand, 'Operations Strategy and Management within Oxfam' (2007), p. 3. Accessed 26 March 2014 at [www.grin.com/en/e-book/69646/operations-strategy-and-management-within-oxfam](http://www.grin.com/en/e-book/69646/operations-strategy-and-management-within-oxfam).

<sup>63</sup> P. Redfield, *Life in Crisis: The Ethical Journey of Doctors Without Borders* (Berkeley, 2013), p. 101. Also known as the Biafran Civil War, which took place from July 1967 to January 1970.

<sup>64</sup> Working for Health: An Introduction to the World Health Organization (World Health Organization, 2007), p. 1.

The route taken by the world's largest democracy from near chaos in the first months of independence to an emerging medical super power was fraught with extraordinary social, economic, military, and political peril. The following work will provide detailed accounts of how the newly independent nation worked to construct its economy on new grounds, thereby making its mark in international affairs, education, and the global economy. These massive changes in a relatively short amount of time resulted in the creation of an entirely new segment of global superiority: the medical technology complex.

Many leaders throughout history have restricted the freedom of the press in order to control the opinions of a nation.<sup>65</sup> In British India, the publication of newspapers in Indian languages was suppressed by the British to avoid the spread of nationalism in India.<sup>66</sup> Even Prime Minister Indira Gandhi attempted to gag the press through her emergency powers, which backfired and caused a greater demand for information.<sup>67</sup> History has also shown that freedom of press can change nations. For example, the Soviet Union's last leader, Mikhail Gorbachev, gave the Soviet people freedom of speech which they used to 'criticize Gorbachev for his failure to improve the economy.'<sup>68</sup> The government could no longer hide serious economic problems from the public. Even as recently as 1995, the communist Yugoslavian government harassed small broadcast and print media.<sup>69</sup> Further, people tend to buy and read newspapers during momentous events; therefore newspapers make sure to report news as quickly as possible during times like

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<sup>65</sup> D.P. Ferguson, 'From Communist Control to Glasnost and Back?: Media Freedom and Control in the Former Soviet Union', *Public Relations Review*, 24 (2) (1998), pp. 165–182, K. Chen and X. Zhang, 'Trial by Media: Overcorrection of the Inadequacy of the Right to Free Speech in Contemporary China', *Critical Arts: South-North Cultural and Media Studies*, 25 (1) (2011), pp. 46–57.

<sup>66</sup> D. Rothermund, *India: The Rise of an Asian Giant* (New Haven, 2008), p. 218.

<sup>67</sup> *ibid.*, p. 223.

<sup>68</sup> The Cold War Museum. Accessed 31 July 2014 at [www.coldwar.org/articles/90s/fall\\_of\\_the\\_soviet\\_union.asp](http://www.coldwar.org/articles/90s/fall_of_the_soviet_union.asp).

<sup>69</sup> Ferguson, 'From Communist Control to Glasnost and Back?', p. 174.

war, famine, changes in laws, etc.<sup>70</sup> Newspapers are the fastest way events are disseminated to the public. Since what is printed in newspapers plays an important role in structuring the thoughts, beliefs, and actions of people, newspaper vignettes will be used in this thesis in order to illustrate how the Indian press was representing India. This thesis will also examine many other sources, including government documents, both official and unofficial, along with newspapers and journals, to show the eventual acculturation of Western medical technology into domestic Indian medical practice.

Chapter 2 of the thesis will begin with an examination of India immediately before independence. It explains that India was, at this time, comprised of two vastly different countries. One was mired in poverty and hunger, whilst the other consisted of small numbers of brilliant scientists, ambitious entrepreneurs, world class biomedical engineers, and creative innovators. The state of healthcare, medical education, natural resources, and medical technology on August 15, 1947 will be examined. Chapter 3 will concentrate on India's journey through post-war, post-colonial, and post-partition chaos during 1947 to 1951. The chapter will also consider the development of the All Indian Medical Institute and the influence of missionaries in India during this time. Chapter 4 focuses on India's development during 1952 to 1963, in particular the roles of international aid to India and the Cold War. Chapter 5 begins with a general analysis of India during the period 1964–1972, i.e. the third and fourth five-year plans, international aid, and increased emphasis on education. Then, the Patents Act of 1970 and its impact on India's future is discussed.

Chapter 6 presents the start of the tremendous growth and advancement in India enabled by the Patents Act of 1970. First, the factors that enabled India to develop its medical technology

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<sup>70</sup> R. Jeffrey, 'Culture of Daily Newspapers in India: How It's Grown, What it Means', *Economic and Political Weekly*, 22 (14) (1987), pp. 607–11. In Britain, the Crimean War increased newspaper sales; in India, the 1971 general elections and the Bangladesh crisis increased newspaper daily circulation by 10 per cent. *ibid.*, p. 608.

complex during 1973 to 1984, such as an English-speaking labour market and international investment, will be examined. India also began to develop medical education facilities and training. Chapter 6 will also discuss the eradication of smallpox in India and globally. Finally, the various theories discussed in the Introduction on the diffusion of Western science and innovations will be analysed and applied to the eradication of smallpox. Chapter 7 will examine the onset of economic liberalization during 1985 to 1991 and its effect on medical technology in India.

Chapter 7 will also discuss the fall of the Soviet Union and how international aid continued to help India grow its medical technology complex. Finally, the Conclusion will summarize India's development from 1947 to 1991. The Conclusion will also examine India post-1991 by focusing on the Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement and the effect the agreement will have on India's future. By the end of this work, the reader should have gained a new perspective on the importance of the development of medical technology in India from both the public health and geopolitical standpoints.

## Chapter 1: A Literature Review of Major Works of Medical History

Life and time are the world's best teachers. Life teaches us to make good use of our time and time teaches us the value of our life – Message and Quotes by Dr. Abdul Kalam.<sup>71</sup>

This literature review will cover two areas. The first will be a review of the history of medical technologies and pharmaceuticals in India from 1947 to 1991, focusing on the constructs and paradigms have been most influential in understanding the development of medical technologies in India. The second area carries that notion forward, and attempts to define the idea of the medical technology complex (MTC). The second section will review the related idea of a national system of innovation (NSI), and highlight the novelty of the MTC concept.

### I. The Historiography of Medicine and Technology in India

Reviewing India's medical technology development prior to independence, it is evident that its primary purpose was to bolster British rule. Over the past two decades, historians have examined the history of medicine under colonial rule.<sup>72</sup> As Daniel Headrick argued in his *Tentacles of Progress: Technology Transfer in the Age of Imperialism 1850-1940*, technology was a way for colonizing powers to establish their rule over indigenous societies.<sup>73</sup> Moreover, according to research carried out by historians of colonial medicine such as Mark Harrison and David Arnold, the need for medical technology was spurred by military necessity and provisions for foreign nationals in India.<sup>74</sup> Harrison's analysis of the development of public health in pre-independence India indicates that the British were providing medical technology in support of their military

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<sup>71</sup> Kalam, A., 'Teacher's Day Quotes, Speech, Messages', (2015) Accessed 22 October 2015 at <http://happyteachersday.org/2015/dr-abdulkalam-teachers-day-quotes-speech-messages.html>

<sup>72</sup> D.R. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (New York, 1981); S. Bhattacharya, M. Harrison, and M. Worboys (eds.), *Fractured States: Smallpox, Public Health and Vaccination Policy in British India 1800-1947* (Vol. 11) (New Delhi, 2005), p. 60.

<sup>73</sup> Headrick, *The Tentacles of Progress*, p. 154.

<sup>74</sup> M. Harrison, *Public Health and Preventive Medicine in British India, 1859-1914* (Cambridge, 2004), p. 144; D. Arnold, *Science, Technology and Medicine in Colonial India* (Vol. 3) (Cambridge, 2000), p. 87.

campaigns. British governors also improved public health conditions in order to curtail major disease outbreaks. Arnold and David Hardiman have both detailed how Christian groups in India used medical technology to enhance their influence with local tribal power structures, such as kings, queens, princes, and princesses.<sup>75</sup>

The aforementioned examples point toward the use of medical technology, treatments, and devices as tools for the exercise and maintenance of power. Local leaders, in turn, received benefits, including the support of military garrisons and reduction in the spread of disease amongst indigenous populations. Both were required to nullify discontent among local populations, mitigate disruptions to agricultural and industrial production, and reduce the potential spread of disease to the metropolis. Nevertheless, as Harrison and Arnold have demonstrated, the use of medical technology in the colonial era was more effective as a bargaining chip for various colonial and military power structures than in improving the lives of the mass of the population.

Many of India's formative medical technology experiences during the time of the British Raj in the early-nineteenth century were the result of foreign intervention.<sup>76</sup> The British Army brought European doctors to India, introducing various therapeutic drugs. Sometimes there were 'acts of therapeutic violence that did more to swell the death-rate than effect lasting cures.'<sup>77</sup> However, not all British governors provided medical devices and maintained public health.<sup>78</sup> Further, due to a lack of resources and native cultural acceptance of Western medicine, there were relatively very few Indians that sought modern medical aid.<sup>79</sup> These early experiences of

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<sup>75</sup> Arnold, *Science, Technology and Medicine*, p. 87; D. Hardiman, *Missionaries and their Medicine: A Christian Modernity for Tribal India* (New York, 2008), p. 38.

<sup>76</sup> *ibid.*

<sup>77</sup> *ibid.*, p. 69.

<sup>78</sup> Harrison, *Public Health in British India*, pp. 83, 184.

<sup>79</sup> M. Harrison, M. Jones and H. Sweet (eds.), *From Western Medicine to Global Medicine: The Hospital Beyond the West* (Hyderabad, 2009).

medical technology would continue to affect the diffusion and adoption rates of pharmaceutical, medical device, and medical supplies into the latter part of the twentieth century.

During this time, India was helped by charitable organizations and foundations, including the International Red Cross Movement, which was established by the Geneva Convention of 1864.<sup>80</sup> Decades later, on March 17, 1920, a dedicated branch of the Indian Red Cross Society (IRCS), a member of the International Federation of Red Cross and Red Crescent Movement, was founded.<sup>81</sup> The IRCS has been one of the largest voluntary blood banks in India since 1962.<sup>82</sup> As Sanjoy Bhattacharya has demonstrated, USAID, the Rockefeller Foundation, and the World Health Organization played a key role in the effort to eradicate the Variola virus.<sup>83</sup> Bhattacharya's research also showed that USAID funded many of the Indian Health Service's eradication campaigns.<sup>84</sup> As multi-lateral agencies, governments, family foundations, and non-profit organizations were buying, distributing, and administering medical technologies, the diffusion of medical technology rapidly increased.

The British introduced a substantial amount of medical technologies to India during the era of the Raj. Historians such as Deepak Kumar, Mark Harrison, and David Arnold have all documented Western medicine and its effect on the native populations in India in the nineteenth and early part of the twentieth centuries. They have shown that Western medical and public health technologies, including sewer systems, clean water systems, and various processes to reduce the risks of epidemics, were introduced in this period. Deepak Kumar's *Science and Empire* provides many cases in which medical technology was imported by the British to

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<sup>80</sup> Indian Red Cross Society, 'About Us.' Accessed 11 August 2014 at <http://www.indianredcross.org/origin.htm>.

<sup>81</sup> *ibid.*

<sup>82</sup> Indian Red Cross Society, 'What We Do, Program and activities.'

<sup>83</sup> S. Bhattacharya, *Expunging Variola: The Control and Eradication of Smallpox in India*, (Hyderabad, 2006), pp. 14, 120, 190.

<sup>84</sup> *ibid.*, p. 120.

improve the economic position of corporations doing business in the subcontinent.<sup>85</sup> The evidence of a medical technology presence in colonial India was elaborated upon in Kumar's work with Roy McLeod, *Technology and the Raj*, in which they demonstrated how medical technology created a dependence on the British.<sup>86</sup>

The convergence of medical technology, colonialism, and the Christian faith was another step in the process of introducing Western medicine to India. In *Science, Technology and Medicine in Colonial India*, Arnold explored the impact of Western medical missions in the subcontinent.<sup>87</sup> He described how the London Missionary Society and other Christian missionaries made medical work, much of it focused on eye glasses and treatments for dengue, a core aspect of Evangelical activity in the belief that healing Hindu bodies would help recruit souls.<sup>88</sup> He also discussed the use of vaccinations despite the complete understanding of immunology and details the use of vaccinations to help reduce the disease of vaccinations and local resistance to those around the sub-continent.<sup>89</sup> Finally, Arnold documented the military's use of medical technology, specifically medicines, so that 'the colonial order remained intact.'<sup>90</sup>

Harrison's *Public Health in British India* details the various technologies that were implemented in India in the mid- to late-nineteenth and early-twentieth centuries.<sup>91</sup> The book describes the water filtration systems the British used during this time to contain bacteria and other pathogens that could spread disease.<sup>92</sup> His research also shows how the Imperial

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<sup>85</sup> D. Kumar (ed.), *Science and Empire: Essays in Indian Context, 1700-1947* (New Delhi, 1991), p. 97.

<sup>86</sup> R.M. Macleod and D. Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India, 1700-1947* (New Delhi, 1995), p. 77.

<sup>87</sup> Arnold, *Science, Technology and Medicine in Colonial India*.

<sup>88</sup> *ibid.*, p. 87.

<sup>89</sup> *ibid.*, pp. 66, 123.

<sup>90</sup> *ibid.*, p. 213.

<sup>91</sup> Harrison, *Public Health in British India*, pp. 182, 249, 311, 314.

<sup>92</sup> *ibid.*, p. 182.

government administered medicine to the Indian population.<sup>93</sup> Throughout Harrison's work, we see evidence of the use and spread of Western medicine and medical technologies in India prior to its independence. Further, Chakrabarti has demonstrated that in early-twentieth century Colonial India medical laboratories had what he describes as a 'moral and institutional entrenchment' in India.<sup>94</sup>

An influential body of work on this effort was B.R. Tomlinson's research on the pre- and post-independence economic history of India. His material on the economic evolution of India from 1860 to 1970 provides a solid foundation regarding the financial environment out of which the pharmaceutical industry developed.<sup>95</sup> His discussion of the Indian economy during the 1920s and 1930s is especially useful for grounding the origins of the Indian pharmaceutical industry. He describes the history of British multinational corporations establishing manufacturing operations in India in order to produce pharmaceuticals.<sup>96</sup> The work also highlights the considerable economic fluctuations experienced in colonial India, the experience of which weighed heavily in the minds of both private and public economic actors throughout the twentieth century.<sup>97</sup> In his article 'Foreign and Private Investment in India, 1920-1950', Tomlinson examines the issue of private FDI in the first half of the twentieth century, concluding that during this formative period there was relatively little private FDI in India.<sup>98</sup> During this period, Tomlinson concludes that India was a 'peripheral area of interest'.<sup>99</sup> This adumbrates the

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<sup>93</sup> *ibid.*, p. 88.

<sup>94</sup> P. Chakrabarti, 'Beasts of Burden: Animals and Laboratory Research in Colonial India', *History of Science*, 48 (2) (2010), p. 125.

<sup>95</sup> B. R. Tomlinson, *The Economy of Modern India, 1860-1970*, Vol. 3 (Cambridge, 1996).

<sup>96</sup> *ibid.*, p. 145.

<sup>97</sup> *ibid.*, p. 253.

<sup>98</sup> B. R. Tomlinson, 'Foreign Private Investment in India 1920-1950', *Modern Asian Studies*, 12 (04), (1978), pp. 655-77

<sup>99</sup> *ibid.*, p. 673.

autarchic policies of the new republic. The early stages of India's life science technology industry did not take place until well into the 1950s.

Before the twentieth century, India did not have any educational institutions devoted to research.<sup>100</sup> All research was carried out by medical officers with their own resources. The first bacteriological laboratory was founded in Agra in 1892. Following the plague in Bombay in 1896, it became even more necessary for India to begin establishing research laboratories, since little was known about how to prevent and end the plague. In 1899, a proposal for research laboratories was submitted and approved by the Provincial governments.<sup>101</sup> In 1906, the Central Research Institute was opened.<sup>102</sup> This was the beginning, as other research institutes were opened over the following 30 years.

<i>Madras.</i> —The Pasteur Institute of Southern India, Coonoor	907
<i>Burma.</i> —The Pasteur Institute of Burma, Rangoon	1915
<i>Assam.</i> —The Pasteur & Medical Research Institute, Shillong	1917
<i>Bengal.</i> —The School of Tropical Medicine, Calcutta	1922
<i>All-India.</i> —The All-India Institute of Hygiene and Public Health, Calcutta	1932
<i>All-India.</i> —The Malaria Institute of India, Delhi	1939

*Table 1: Institutes and laboratories founded and opened in India in the years stated*<sup>103</sup>

A challenge India faced with the spread of medical technology, in particular Western technology, was the resistance from its spiritual leadership. The clash between the spiritual and political leadership regarding the adoption of medical technology in post-independence India led

<sup>100</sup> Report of the Health Survey and Development Committee, Vol. I (New Delhi, 1946), p. 176. Accessed 16 July 2014 at [www.nhp.gov.in/bhore-committee](http://www.nhp.gov.in/bhore-committee).

<sup>101</sup> *ibid.*

<sup>102</sup> *ibid.*, p. 177.

<sup>103</sup> *ibid.*

to frequent conflicts. Local populations resisted the administration of medical technology and there was widespread scepticism amongst India's population, especially in tribal areas, concerning the safety and efficacy of injections, drops, and pills being promoted by strange people from foreign lands.<sup>104</sup> Another issue was purity: both Hindus and Muslims were troubled by rumours asserting that these drugs contained, variously, cow's blood and alcohol, which, though untrue, contributed to an atmosphere of distrust.<sup>105</sup> Some tension existed between advocates of specific preventive technologies and proponents of general sanitary works. Finally, when medical technology was introduced into the subcontinent through foreign military sources, as well as foreign medical missionaries, it was generally distrusted by the Indian population.

## **II. Works on the History of Pharmaceuticals in India**

Works about the patent history of India have accumulated because of fascination with the nation's rapid regulatory pivots over the course of the last forty years, as well as its overall success. American historians and legal analysts have recognized the insights to be gleaned from this history and more recent innovations.

Most publications on the history of medical technology in India have been written by Indians in the field of medical devices and pharmaceuticals or by academics from the United States. The foremost work is Smita Srinivas's *Technological Learning and the Evolution of the Indian Pharmaceutical and Biopharmaceutical Sectors*, which provides a comprehensive look at the development of the Indian pharmaceutical industry from 1991 to 2004.<sup>106</sup> She created a techno-learning framework for innovation in Indian pharmaceuticals. She conducted an

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<sup>104</sup> A.D. Mishra, *Revisiting Hind Swaraj* (New Delhi, 2010), p. 90.

<sup>105</sup> *ibid.*

<sup>106</sup> S. Srinivas, 'Technological learning and the evolution of the Indian pharmaceutical and biopharmaceutical sectors', Ph.D. Thesis, Massachusetts Institute of Technology, 2004.

extensive number of interviews, compiling a contemporary oral history of the development of the Indian pharmaceutical industry. Srinivas's work was primarily focused on India's transformation from generics manufacturer to innovator. In her treatment of India's pharmaceutical industry, Srinivas provides the following chronology of institutional change in the Indian pharmaceutical industry:

Period	Initiative and Effect
Pre-1947	<p>British-friendly patent law. Imports dominate the market. Local production low and multinational companies thrive</p> <p>1901 First Indian pharmaceutical company reported open</p> <p>1904-1907 British establish several research centres for tropical diseases.</p> <p>1914-1918 World War I. Imports cut off. Local demand grows and local industry builds capability</p> <p>1919 First drugs safety law enacted</p> <p>1931 Drugs Enquiry Committee established to monitor prices and propose price controls.</p> <p>1939-1945 World War II Imports cut off. Local industry continues to grow. India begins to produce conventional drugs as well as vaccines and serums. Dysentery and leprosy drugs begin.</p>
1950-1970	<p>Indian independence and creation of the Republic. Period of rapid industrialisation building on pre-World war II manufacturing experience.</p> <p>Establishment of public sector research centre network in key locations. Hindustan Antibiotics Limited (1954) and IDBL (1961), Hyderabad established, for example and becomes an industry pioneer.</p> <p>1955-1960 Second Five-Year Plan. Government places pharmaceutical industry together with other chemical-based industries for integrated development planning.</p> <p>1960-1965 Third Five-Year Plan. Government fuels public sector enterprises growth nationwide. Manufacturers produce penicillin, streptomycin and antibiotics of the tetracycline group. Firms establish foreign collaborations to acquire technical knowledge and develop synthetic drugs and alkaloids.</p>
1970-1972	<p>Drug Price Control Order 1970 serves to severely regulate the market vis-à-vis wholesale and retail prices. Serves to increase competition and number of smaller companies.</p> <p>Patents Act 1970 recognises only product patents and patents for production processes for 7 years. Serves to create protections for Indian firms while they learn and excel at process chemistry and engineering.</p>
1978	New Drug Policy structures manufacturing capabilities through procurement and allocation
1980-86	<p>1982 establishment of National Biotechnology Board. 1986, end of the Board's mandate. Identified focus areas for biotechnology and hurdles.</p> <p>1986 Establishment of the Department of Biotechnology (still in existence) under the Ministry of Science and Technology to coordinate multi-disciplinary S&amp;T capability building.</p>
1986-1991	<p>Objective to establish a network of biotech-competence in the country. Grants disbursed liberally.</p> <p>Creation of the Centre for Cell and Molecular Biology, Hyderabad</p> <p>Also creation of National Institute of Immunology, International centre for Genetic Engineering, New Delhi (with United Nations Industrial Development Organisation, UNIDO, assistance)</p> <p>Serves to deepen and widen the competence network and institutionalise biotechnology importance in the country</p>
1990	Establishment of the Biotechnology Consortium of India BCIL, a public-sector company to provide public financing to industry in the absence of private venture capital.
1991	<p>Balance of Payments crisis. India's New Economic Policy. Rethinking of State role. Funds crisis deepens for national laboratories. Liberalisation of the Indian economy continues (begins in the mid-1980s).</p> <p>Multinational firms increase presence with relaxed controls on foreign ownership. However, increased competition eventually forces some MNCs to exit the market.</p>
1991-present	Continued DBT activity, including new Millennium initiatives to network private and public sector capability. CSIR laboratories continue to open up and work with industry. IISc and NCBS also open up and deepen links with private sector. State-funded research in national centres continues for public health remedies.

Table 2: Srinivas's Chronology of Institutional Change in Indian bio-pharmaceuticals<sup>107</sup>

<sup>107</sup> *ibid.*, pp. 57-58.

Her account begins during the colonial period, when the first Indian pharmaceutical companies started operating, and continues up until full liberalization from 1991 onwards. The colonial period begins with the foundation of the first Indian pharmaceutical company in 1901 and extends through the Second World War to independence. The following period runs from 1950 to 1970, when India's first five-year plans were established and included substantial funding for public health and pharmaceuticals.<sup>108</sup> The era from 1970 to 1972 is demarcated to show the magnitude of the effect of both the Patents Act and the Drug Price Control Order on the pharmaceutical industry. The next significant moment, according to Srinivas, was 1978, when new drug policies for manufacturing, procurement and allocation were introduced.

The phase from 1980-86 involved not only reforms, but also the introduction of a national biotechnology board. 1986-91, the pre-liberalization era of Rajiv Gandhi, marks the beginning of a looser regulatory structure designed to 'widen the confidence network in the biotechnology industry in the country.'<sup>109</sup> 1991 marks the beginning of the liberalization of economic policies in India, when multinational firms were first allowed to gain increased equity in domestic pharmaceutical companies. This last period is characterized by the rapid growth of Indian pharmaceutical companies in an era of global health. Srinivas's next work, *Market Menagerie: Health and Development in Late Industrial States*, was a broader look at the poor health care infrastructure plaguing India today.<sup>110</sup> In it, she juxtaposes India as a world leader in pharmaceuticals with its rank as one of the worst in terms of healthcare outcomes.<sup>111</sup>

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<sup>108</sup> *ibid.*, p. 57.

<sup>109</sup> *ibid.*, p. 58.

<sup>110</sup> S. Srinivas, *Market Menagerie: Health and Development in Late Industrial States* (Stanford University Press, 2012).

<sup>111</sup> *ibid.*, p. 313.

One of the key sources on the history of the Indian pharmaceutical industry, ‘Globalization and the Indian Pharmaceutical Industry’, was written by Sunil Sahu.<sup>112</sup> He outlined four phases in the development of the Indian pharmaceutical Industry. The first began in 1948 and ended in 1968, and is described as the period in which India moved from a colonial infrastructure to multinational monopoly control of industry. The second phase, which ran from 1969 to 1978, is centred on the effort to curb the monopoly of drug transnationals. It began with the Patents Act of 1970, and concerns a period in which the Indian government loosened some restrictions and regulatory constraints. This period ends in 1978, when the government began to lift some price controls and allow the drug industry more operational freedom. The third phase ran from 1978 to 1985 and witnessed the emergence of a strong national sector; it addresses the first stages of liberalization carried out by Rajiv Gandhi in 1985. The fourth phase, 1985-95, is the period of full liberalization. At this time, both domestic investment and foreign direct investment grew substantially, as the number of drugs governed by price controls was cut, allowing for an increase in profitability.<sup>113</sup> Though his conclusions are focused on the effects of government policies on the profitability and sectoral growth within the industry, Sahu provides a structured analysis of the history of Indian pharmaceuticals. Sahu was also the author of one of the most comprehensive works on the history and structure of the Indian pharmaceutical industry, *Technology Transfer, Dependence, and Self-Reliant Development in the Third World*, which provides a detailed account of the growth of the pharmaceutical and machine tool industries.<sup>114</sup>

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<sup>112</sup> S.K. Sahu, ‘Globalization and the Indian Pharmaceutical Industry’, published by the International Political Science Organization, [http://paperroom.ipso.org/papers/paper\\_196.pdf](http://paperroom.ipso.org/papers/paper_196.pdf) (accessed 19 October 2015).

<sup>113</sup> *ibid.*, p. 12.

<sup>114</sup> S.K. Sahu. *Technology Transfer, Dependence, and Self-Reliance Development in the Third World: The Pharmaceutical and Machine Tool Industries in India* (Praeger Publishers), 1998.

A World Bank technical paper published in 1997 provides a short treatment of India's pharmaceutical history.<sup>115</sup> Chapter 2, written by Shekhar Chaudhuri, illustrates the growth of the Indian pharmaceutical industry. She states that roughly 90% of the production of India's pharmaceuticals comes from indigenous firms. Chaudhuri outlined the growth of production within the pharmaceutical industry, from roughly 210 million rupees in 1950 to over 71 billion rupees in 1992.<sup>116</sup> She goes into describe the transfer of Soviet technology in 1961 that assisted in building five pharmaceutical plants in India. The importance of Soviet aid during the 1950s and 1960s is highlighted in this thesis as one of the key drivers of India's development in this foundational era.

Another critical work is Pratik Chakrabarti's work *Medicine and Empire*.<sup>117</sup> Chakrabarti provided significant evidence concerning the post-colonial development of medicines through 1960. His emphasis on the importance of medical research and education is critical in explaining the foundational components of India's MTC.

A book that is nearly unavailable in the West, but obtainable in India is P.K. Ravindranath's *The Indian Pharmaceutical Industry Since Independence*.<sup>118</sup> Ravindranath has been a political analyst and columnist for Indian newspapers for the past forty five years. His popular work provides a personal account of the rise of the Indian pharmaceutical industry through the latter half of the twentieth century. It primarily highlights his experience with Sandoz India, a Swiss multinational joint venture that grew substantially in India in the middle of the twentieth century and was significantly impacted by the Patents Act of 1970.

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<sup>115</sup> G. Felker, S. Chaudhuri, and K. Gyorgy, *The Pharmaceutical Industry in India and Hungary: Policies, Institutions and Technological Development*, World Bank Technical Paper No. 392, Washington, World Bank, 1997.

<sup>116</sup> *ibid.*, p. 8.

<sup>117</sup> P. Chakrabarti, *Medicine and Empire, 1600-1960* (Palgrave, 2013).

<sup>118</sup> P.K. Ravindranath, *The Indian Pharmaceutical Industry Since Independence* (English Language Press, 2001).

A similar book, also only available in India, is *Technological Development in Drugs and Pharmaceutical Industry in India* by Husain Ahmad.<sup>119</sup> Ahmad's work covers a significant amount of statistical data concerning the volume of manufacturing, as well as the numbers and ratios of scientists and the size of research and development offices in India's pharmaceutical companies. It goes into detail on the sales of various drugs during different periods of time. Ahmad is a chemical engineer by training and therefore much of his work is a history of the research and development side of the pharmaceutical industry in India.

In their paper 'Fifty Years of Immunization in India', Vashishtha and Kumar present a significant volume of data about demand for vaccinations in India.<sup>120</sup> Their data was collected as part of the UN and WHO's Universal Immunization Program (UIP), and shows that 43% of UIP vaccinations are actually manufactured in India. They explain that the Serum Institute, India's leading measles vaccine manufacturer, is the largest in the world. The article also discusses regulatory and ethical efforts in India, and present evidence as to how the Indian drug regulatory system is overburdened. Vashishtha and Kumar's work is an important piece of empirical evidence on the development of the Indian pharmaceutical industry since 1991.

One of the most important accounts of the evolution of the Indian pharmaceutical industry was written by Mainak Mazumdar.<sup>121</sup> His book cites Porter's work in terms of strategies that firms developed distinguishing themselves in terms of marketing and promotion, and thus by 'superior brand image'; or through reputation founded upon innovation that creates new product varieties.<sup>122</sup> An important finding of the book is that, in most instances, national policies evolve

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<sup>119</sup> H. Ahmad, *Technological Development in Drugs and Pharmaceutical Industry in India* (Navrang, 1988).

<sup>120</sup> V.M Vashishtha, and P. Kumar, 'Fifty Years of Immunization in India: Progress and Future', *Indian Pediatrics*, 50 (1), 2013, pp. 111-118.

<sup>121</sup> M. Mazumdar, *Performance of Pharmaceutical Companies in India: A Critical Analysis of Industrial Structure, Firm Specific Resources, and Emerging Strategies*, (Springer Verlag, 2012).

<sup>122</sup> *ibid.*, p. 129.

from protection to competition. This allows industries such as pharmaceuticals to become competitive globally and more sustainable in general. The book provides important insights regarding how and why for-profit institutions were motivated by India's potentially massive marketplace, as well as its low-cost production facilities.

Mazumdar has gone on to publish several other works on the performance of Indian pharmaceutical firms. In his 2013 article, 'Profitability of Indian Pharmaceutical Firms', his conceptual framework is subjected to the structure-conduct-performance paradigm, in which the profits of the pharmaceutical companies are highly dependent upon the industrial structure that surrounds them.<sup>123</sup> The pharmaceutical industry is a good case study due to the frequent changes in the regulatory structure of the industry, which shift from state control to liberalization in a manner that can be seen immediately.<sup>124</sup> This is highly instructive when considering the MTC's ability to assist in the growth of an already potent industry.

Changes to the regulatory structure of India's biopharmaceutical and medical technology industries help to explain their rise; this has included new government agencies as well as policies. One of the most important works on regulatory power structures around the world is the Daniel Carpenter's 2014 work *Reputation and Power: Organizational Image and Pharmaceutical Regulation at the FDA*.<sup>125</sup> Carpenter highlights the variations in regulatory structures at the state level, in terms of both organizational capacity and enforcement policies.<sup>126</sup> He also goes into detail about the Ayurvedic component of India's drug industry and the rivalry between traditional and Western medicine, particularly under regulatory guidelines. Carpenter describes the FDA's relationship with the Indian pharmaceutical industry in the 1980s, when

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<sup>123</sup> M. Mazumdar, 'Profitability of Pharmaceutical Companies in India', Contributions to Economics, (2013)

<sup>124</sup> *ibid.*, p. 128.

<sup>125</sup> D. Carpenter, *Reputation and Power: Organizational Image and Pharmaceutical Regulation at the FDA*, (Princeton University Press, 2014).

<sup>126</sup> *ibid.*, p. 654.

quality control issues surfaced. A turning point in that relationship occurred when the Indian government began enforcing good manufacturing processes (GMPs) and good clinical practices (GCPs) in the manufacturing and research processes in the country.<sup>127</sup> This important strategic change occurred at the moment that the Soviet Union was collapsing and India began shifting its exports towards Western markets.

David Hardiman's book *Healing Bodies, Saving Souls: Medical Missions in Asia and Africa* provides a fascinating account of the topic from different perspective.<sup>128</sup> His text covers the history of medicine and the work of medical missionaries in India through the 1960s. The book references the use of medical technology by missionaries in India and allows one to glean insights into that history. Hardiman's previous book, *Missionaries and their Medicine: A Christian Modernity for Tribal India*, covers an earlier part of the history of medical technology in India, through the 1940s.<sup>129</sup>

Another work critical for this thesis was a report produced by a team of three Indian researchers at the Institute of Economic growth led by Professor Andrani Gupta. The book, *Adoption of Healthcare Technologies in India: Implications for the AIDS Vaccine*, details case studies of how medical technologies to fight HIV/AIDS and Hepatitis B, as well as a universal immunization program, were distributed and implemented across the subcontinent through the 1980s.<sup>130</sup> This details the barriers and opportunities for the diffusion of medical technology in a developing country.

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<sup>127</sup> *ibid.*, p. 721.

<sup>128</sup> D. Hardiman (ed.), *Healing Bodies, Saving Souls: Medical Missions in Asia and Africa* (Editions Rodopi, 2006).

<sup>129</sup> D. Hardiman, *Missionaries and their Medicine: A Christian Modernity for Tribal India* (Manchester University Press, 2009).

<sup>130</sup> A. Gupta, M. Trivedi, S. Kandamuthan, *Option of Healthcare Technologies in India: Implications for the AIDS Vaccine* (SAGE Publications, 2007).

Many works about the patent history of India have appeared due to fascination with the nation's rapid regulatory pivots over the course of the last forty years, as well as its overall success. Visalakshi and Sandhya argued that, contrary to the generally held belief, the Drug Price Control Order and the Patents Act had the effect of cooling R&D efforts.<sup>131</sup> They provided data to support their claim that these policies reduced the number of new agents tested in India because foreign firms no longer wanted to introduce new molecular entities into a country that was taking those ingredients and making new products. Another article on the history of India and its Patents Act was authored by A.K. Bagchi et al.<sup>132</sup> Their work asserts that the Patents Act was not the result of deliberate engineering of government policy, but rather an opportunistic reaction to the relative disarray of the international community in light of the humanitarian needs of India and other developing countries.<sup>133</sup>

The most comprehensive work on the history of patents in India is Janice Mueller's 151-page article, 'The Tiger Awakens: The Tumultuous Transformation of India's Patent System and the Rise of Indian Pharmaceutical Innovation'.<sup>134</sup> Published in 2007, her article underscores the point that India's pharmaceutical and medical technology policies are always evolving, and require significant clarification when implemented.<sup>135</sup> Jean O. Lanjouw, meanwhile, described the effects of the international patents regime in her paper, 'The Introduction of Pharmaceutical Product Patents in India: "Heartless Exploitation of the Poor and Suffering"?' Her essay

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<sup>131</sup> S. Visalakshi and G.D. Sandhya, 'R&D in Pharma Industry in Context of Biotech Commercialisation', *Economic and Political Weekly*, Vol. 35 No. 48 (2000), p. 4223.

<sup>132</sup> A.K. Bagchi, P. Banerjee, and U.K. Bhattacharya, 'Indian Patents Act and Its Relation to Technological Development in India', *Economic and Political Weekly*, 1984, p. 287.

<sup>133</sup> *ibid.*, p. 302.

<sup>134</sup> J.M. Mueller, 'The Tiger Awakens: The Tumultuous Transformation of India's Patent System and the Rise of Indian Pharmaceutical Innovation', *University of Pittsburgh Law Review*, 68 (3), 2007.

<sup>135</sup> *ibid.*, p. 638.

highlights the 1961 Senate testimony of Senator Estes Kefauver that ‘India ranks as one of the highest-priced nations in the world.’<sup>136</sup>

Mona Mourshed provided another introduction to the Indian pharmaceutical industry in her 1999 MIT dissertation, which highlights the growth of the Indian pharmaceutical industry from the 1960s to the 1990s. One table shows how the number of pharmaceutical firms in India rose from 2,257 in 1969 to 23,700 by the end of 1996, and shows how the Indian government stimulated high growth through demand regulation and pricing policy pivots. Finally, though not a work on the history of pharmaceuticals or medical technology, Santosh Mehrotra’s book, *India and the Soviet Union: Trade and Technology Transfer*, provides a detailed treatment of the Soviet Union’s influence on the pharmaceutical industry in India during from the 1960s until the fall of the Soviet Union.<sup>137</sup>

### **III. Theoretical Background**

This section highlights the term ‘medical technology complex’ and reviews the literature regarding other theoretical constructs to which it bears some resemblance. By the end, the reader should have a broad understanding of the constructs upon which the concept of the medical technology complex has been built.

This thesis distinguishes between the medical technology complex, the medical technology industry, and the pharmaceutical industry. Medical technology is traditionally defined as any kind of molecule-, device-, software-, or hardware-based product or service that is

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<sup>136</sup> J. O. Lanjouw, ‘The Introduction of Pharmaceutical Product Patents in India: “Heartless Exploitation of the Poor and Suffering”, No. w6366. *National Bureau of Economic Research*, 1998.

<sup>136</sup> M. Mourshed, ‘Technology Transfer Dynamics: Lessons from the Egyptian and Indian Pharmaceutical Industries’, Ph.D. thesis, Massachusetts Institute of Technology, 1999.

I DON’T KNOW WHY THIS GIANT GAP IS APPEARING HERE – I CAN’T GET RID OF IT

<sup>137</sup> S. Mehrotra, *India and the Soviet Union: Trade and Technology Transfer* (Cambridge University Press, 1990).

involved in human health. The medical technology industry is an aggregation of productive activities surrounding different forms of technology, of which the pharmaceutical industry is only one part. The medical technology complex is in turn based on the medical technology industry, and additionally includes stakeholders whose preferences form a dominant role in the decision-making matrix within the industry.

It is true that the pharmaceutical industry has been a catalyst for growth and has therefore attracted most academic attention, earning India the epithet 'Pharmacy of the World'. However, the growth of the biotechnology, genetics, medical-device, and information-systems aspects of India's medical technology industry have also been substantial. In other words, the thrust of this thesis is that the growth of a biomedical sciences ecosystem in India from 1947 to 1991 has had substantial effects not only on the pharmaceutical industry, but also on other areas of the overall industry. For example, though the effects of the complex on the medical device industry have not been as significant as in the pharmaceutical industry (for reasons covered in this thesis), they have nonetheless been substantial. The best known case study in the past five years has been the development of the portable ultrasound by a team in Bangalore. This development emerged out of a need for portable diagnostic tools to be used in undeveloped, rural regions of India. The ultrasound has been sold widely and physicians now have access to kits that are the size of a briefcase and cost only \$7,000 USD. The focus of this work is on the medical technology industry as a whole, and covers case studies concerning not only antibiotics and vaccines, but also X-ray machines and ultrasounds.

The medical technology complex comprises a variety of different organisations united by the primary goal of improving patient care, but distinguished by their secondary goals. The MTC includes the Indian government and foreign governments, nonprofits, NGOs, multilateral

organisations, religious organisations, private foundations, for-profit corporations, and high-net-worth individuals. In terms of private corporations, the MTC does not merely include pharmaceutical companies, but also medical device companies, medical instrument and machine companies, medical supply companies, genetics and biotechnology companies, and information technology companies. These actors are engaged in the funding, research, development, distribution, and implementation of their technologies across the global health care system.

The stakeholders of the MTC have vastly different secondary objectives, though with the common objective of self-perpetuation. For example, a for-profit medical device company, though focused primarily on the improvement of patient outcomes, has the secondary objective of achieving commercial sustainability and growth through its profit-generating activities from patient care. The managers of private foundations perpetuate themselves by meeting the objectives of the foundation, as defined by the original long-term goals of the settlor and by the medium-term goals of the board of directors. The consequence of the failure to meet these goals is essentially termination, not only of the executive leadership, but also of the staff, engendering substantial motivation. For example, the executive leadership of the Gates Foundation must meet quantitative objectives of improving maternal and child health set by the board annually, and do so through investments in medical technology around the world, carefully placed to have measurable results over time. The cultures of for-profit corporations and charitable foundations are different, but their primary goals and internal dynamics are quite similar.

Michael Porter has touched upon one critical element of the MTC, philanthropy.<sup>138</sup> He lists four elements of ‘competitive context’, one of which is corporate philanthropy. Companies engage in cause-related marketing in order to increase their overall brand recognition and

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<sup>138</sup> M. Porter and M. Kramer, ‘The Competitive Advantage of Corporate Philanthropy’, *Harvard Business Review*, 80 (12), (2002), pp. 56-68.

credibility.<sup>139</sup> He distinguishes strategic philanthropy, which has a social impact, from cause-related marketing, which does not, and ultimately misses the mark of building good will and thus enabling the company to compete. He asserts that strategic philanthropy actually addresses critical social issues through the organization's distinctive capabilities. By its nature, the MTC makes a social impact, viz., improving patient outcomes, which fits within Porter's scheme.

In his 1995 paper, 'Technopoles of the World', Manuel Castel outlines the term 'industrial complex' as part of how he saw the development and rapid growth of information and communications technology firms in Silicon Valley.<sup>140</sup> He outlines a series of key factors for innovation in the information age. These include: 1) new raw material, defined as new scientific material, advanced technology, and education; 2) high risk capital, through either venture capital firms or government grants; and 3) the availability of scientific talent and labour. The technopole theory was concerned primarily with information and communications technologies rather than medicine and public health, and focused on private corporations, governments, and universities. Castel's 2014 book, *Technopoles and the World: The Making of the Twenty-First Century*, builds upon his earlier work, further defining industrial complexes as groups of stakeholders from private corporations, universities, and governments.<sup>141</sup> This definition is ultimately derived from U.S. President Dwight Eisenhower's use of the term 'military-industrial complex'. Castel's work shows similarities to the MTC in terms of structural connotations of multiple stakeholders working together towards a common goal but with different agendas. His argument is therefore highly instructive in defining the MTC.

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<sup>139</sup> *ibid.*, p. 6.

<sup>140</sup> M. Castells, P. Hall, & L. Jennings, *Technopoles of the World: The Making of 21<sup>st</sup> Century Industrial Complexes* (Routledge, 2004).

<sup>141</sup> *ibid.*, p. 7.

The theoretical backdrop of the MTC comprises two similar theoretical models: the National Systems of Innovation (NSI), developed principally by Freeman and Lundvall, and the Sectoral System of Innovation (SSI), developed principally by Malerba. The NSI construct has evaded explicit definition for thirty years. Freeman defines it as a network of institutions in the public and private sector; Lundvall's definition focuses more directly on the diffusion of economically useful knowledge; and Nelson's 1993 definition emphasizes interactions among institutions. What emerges is a broad understanding of the alignment of primary goals and outcomes of different stakeholders and institutions within the NSI model. In Lundvall's hallmark work, *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*, he states that the key outcome of a national innovation system is economic growth.<sup>142</sup> The concept has been applied to many problems in national economic development: in their 1993 chapter, 'Comparing the Danish and Swedish Systems of Innovation', Edquist and Lundvall apply the NSI model to small, high-income countries to determine the effectiveness of their systems.<sup>143</sup> Looking at countries such as Australia, Denmark, and Sweden, the researchers that the intensity of the R&D culture of a country does not necessarily correspond to the absorption of R&D intensive products. This accords with Srinivas's argument in *Market Menagerie*, that whilst there are advanced medical technologies produced by the millions in India, it still carries some of the world's worst health outcomes.

In his 1992 paper 'National Innovation Systems: A Retrospective on a Study', Richard Nelson presented a comparative study of a large number of national innovation systems.<sup>144</sup>

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<sup>142</sup> B.A. Lundvall, *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*, Vol. 2, (Anthem Press, 2010).

<sup>143</sup> C. Edquist & B.A. Lundvall, 'Comparing the Danish and Swedish Systems of Innovation' in E. Nelson, *National Innovation Systems: A Comparative Analysis*, (Oxford University Press, 1993), pp. 265-298.

<sup>144</sup> R.R. Nelson, 'National Innovation Systems: A Retrospective on a Study', University of California at Berkeley, Center for Research in Management, Consortium on Competitiveness & Cooperation, 1991.

Dozens of countries were surveyed, including large industrialized countries, small high income countries, and emerging industrial states.<sup>145</sup> To date, this study is the largest in terms of both absolute numbers of countries considered and range of economic diversity among those countries from an NSI perspective. Although he does not address India, Nelson does emphasize the importance of sectoral systems of innovation; in this framework, universities are critical components of innovation.

One of the key theoreticians in this area has been Professor Xiaolan Fu, whose theoretical frameworks have focused on how innovation, technology, and industrialization are connected. Fu has, at times, employed the NSI model to examine the interaction between nations, technology acquisition, and adaptation. These concepts are critical in understanding the diffusion of high technologies such as pharmaceuticals in emerging economies over the last 50 years.<sup>146</sup> Her economic analysis of China's role in the global economic recovery provided insight into India's overall capital structure.<sup>147</sup> This is applicable to India's pharmaceutical and medical technology industries, since their long-term survival depends upon India's overall economic sustainability. According to Fu, India is still economically at risk because it is still a net capital importer.<sup>148</sup> However, she goes on to state that India does have a substantial domestic market upon which to rely in case of global economic downturn.

Another one of Fu's papers on innovation focused on the photovoltaic industries in China and India.<sup>149</sup> She examined how indigenous innovation could enable China and India leapfrog international competition innovation in green technology. The NSI model is central to this

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<sup>145</sup> *ibid.*, p. 347.

<sup>146</sup> Fu, X. *China's Path to Innovation* (Cambridge, 2015).

<sup>147</sup> Fu, X. (ed.). *China's Role in Global Economic Recovery* (London, 2012).

<sup>148</sup> *ibid.*, p. 113.

<sup>149</sup> Fu, X., & Zhang, J. 'Technology Transfer, Indigenous Innovation and Leapfrogging in Green Technology: The Solar-PV Industry in China and India', *Journal of Chinese Economic and Business Studies*, 9 (4), (2011), pp. 329-347.

analysis.<sup>150</sup> Government agencies and private firms have worked closely together, but the former played a strong role in adjusting regulatory frameworks and other systemic conditions in order to increase market demand. This is immediately relevant to the subject matter of this thesis: the NSI model, when applied to India's growth, explains much of the cohesion between the nation's private pharmaceutical sector and evolving government agencies. It also explains the important role played by policy makers in both the Patents Act 1970 and the Drug Price Control Order of 1970.

In their 2002 paper, 'The Determinants of National Innovative Capacity', Porter, Furman, and Scott compare the ideas-driven work of Romer, the cluster-based theory of Porter, and the national systems of innovation theory of Nelson.<sup>151</sup> The authors state that Nelson's national systems literature focused on the role of national policy, university education, and nationally oriented institutions.<sup>152</sup>

Chris Freeman's article, 'The National System of Innovation: A Historical Perspective' is a key work in the National Systems of Innovation literature, and highlights an element central to the MTC, viz., the role played by transnational corporations.<sup>153</sup> Freeman writes that it is essential that transnational corporations interact with national systems to ensure efficient innovation.<sup>154</sup> This insight is critical, as the MTC comprises not only transnational corporations, but also transnational foundations, non-profits, religious organizations, multilateral agencies, and other organizations with the objective of improving patient care. There is a close relationship between the two concepts, as they comprise similar actors to some degree.

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<sup>150</sup> *ibid.*, p. 329.

<sup>151</sup> J. Furman, M. Porter, and S. Stern, 'The Determinants of National Innovative Capacity', *Research Policy* 31 (2002) 899–933.

<sup>152</sup> *ibid.*, p. 2.

<sup>153</sup> C. Freeman "The 'National System of Innovation' in Historical Perspective." *Cambridge Journal of Economics* 19.1 (1995), pp. 5-24.

<sup>154</sup> *ibid.*, p. 17.

One of the more intriguing concepts in Lundvall's *National Systems of Innovation* concerns what he terms 'systems of irrationality'. Developed by public administration scholars Snellen and van de Donk, the theory explores different types of behaviour within a national system.<sup>155</sup> These theorists break irrationality down into four systems: economic, political, scientific, and humanitarian. These systems have some explanatory power in explaining the behavioural attributes of the MTC. Actors such as non-profits, foundations, and multilateral agencies have provided India with tens of billions of dollars of funding with little to show in return. Such actors include private foundations such as the Rockefeller Foundation, which provided funding for regional health centres, and the government of New Zealand, which helped fund the All India Institute of Medicine. Their behaviour could be interpreted as economically irrational in that it had a low and indirect return on investment. On the other hand, such actions can also be seen as a manifestation of humanitarianism or a reflection of geopolitical circumstances.

Franco Malerba's 2004 book, *Sectoral Systems of Innovation*, provides an additional framework for the analysis of innovation in several sectoral systems. One of the sectors analysed includes pharmaceuticals and biotechnology firms.<sup>156</sup> He goes into detail about the coevolution of incentives over time, focusing on the patent protections that came and went in Italy during the late 1970s. The fluctuations in protection that occurred in Italy were similar to what occurred in India. Malerba's framework does not, however, include the activities and efforts of transnational organizations that will receive explicit attention in this thesis; in the MCT, all of these institutions play a pivotal role in the diffusion of medical technology.

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<sup>155</sup> T.M. Snellen and W.B.H.J. van de Donk, *Expert Systems in Public Administration: Evolving Practices and Norms* (Elsevier, 1989), cited in Lundvall, *National Systems of Innovation*, p. 137.

<sup>156</sup> F. Malerba, *Sectoral Systems of Innovation: Concepts, Issues, and Analyses of Six Major Sectors in Europe* (Cambridge University Press, 2004), p. 114.

<b>Unit of Analysis</b>	<b>National System of Innovation (NSI)</b>	<b>Medical Technology Complex (MTC)</b>
Planning Model	Coordinated	Uncoordinated
Collaboration	Integrated	Dis-integrated
Types of Activities	Research and Production	Research, Development, Production, Distribution, Implementation, Diffusion
Key Entities	Business, Government, Academic	Government, Multi-Lateral, NGO, Religious, Academic, Foundation, For-Profit
Primary Objective	Economic Development	Patient Outcomes
Driver	Innovation	Diffusion

*Table 2: Comparing the National System of Innovation and MTC*

One of the factors that distinguishes the MTC concept from the national systems of innovation theory is that which is considered to be the driver of each period. In his article, ‘National Systems of Innovation in Historical Perspective’, Freeman described the surreptitious use of government funds by Prussia to import metalworking technologies from Britain as a critical factor in the overall success of metal working in Germany. The paper concluded, by contrast, that no single factor could explain Britain’s success with metalworking innovations during the late nineteenth century. Freeman pointed out that Britain’s success was attributed to ‘a combination of interacting social, economic, and technical changes within its national economic

space.<sup>157</sup> India had similar variables that led to the development of its medical technology industry following independence. As in Britain, a number of factors converged in India, including participation in the Commonwealth, a network of Indians around the world, and an historically rooted scientific network in the Commonwealth with a well-developed apparatus for fighting diseases such as malaria, dengue, yellow fever, and tuberculosis.

One of the most remarkable aspects that affected the rise of the medical technology industry was the amount of investment made by foreign entities, including foreign governments, particularly the United States, Britain, and New Zealand; multilateral agencies such as the WHO, UNICEF, and the IMF; independent charitable foundations; and many other stakeholders that provided tremendous grants and loans to maintain the viability of India's democracy. This unique geopolitical constellation arose to prevent the rise of Communism in India and is unlikely to be replicated. The Cold War situation distinguishes India's experience from those of Egypt, Turkey, and Malaysia, which, though also outside the orbit of the Soviet Union, had substantially different domestic political dynamics.

In national and sectoral systems of innovation, actors engage in innovative activity with the goal of realizing profits for themselves. The same is not true of the medical technology complex, in which actors share the goal of improving patient care. For-profit corporations form only one set of stakeholders within the larger complex, which includes other actors motivated by factors other than profit. These actors include governments, NGOs, and foundations; though they are motivated by the goal of perpetuating their existence, such perpetuation is not linked to profitability; in the case of private non-profit organizations, perpetuation is determined simply by the fulfilment of the charitable goal of the organization. Differences in motivation are the critical distinction between the systems of innovation approaches and the MTC concept.

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<sup>157</sup> *ibid.*, p. 19

The medical technology complex is also distinguished from the national systems of innovation construct in that it moves from a passive to an active state. The passive state of the MTC is the status quo. Much like the NSI model, actors in the passive state of a complex act on a regular basis towards the objective of their organization, which, in the case of an MTC, is the provision of medical services, albeit in a disintegrated and uncoordinated manner. However, a complex such as an MTC can move from a passive state to an active state, in which the goals of the different actors align and the structure is outcome-driven, rather than process- or activity-driven. This phenomenon can be seen in several case studies, notably the eradication of smallpox, the near eradication of polio, the movement to reduce the spread of HIV/AIDS, and most recently the international response to the Ebola epidemic in West Africa.

The case study of smallpox shows how countries politically opposed to each other came together, along with international agencies, to help eradicate a global disease. The eradication of smallpox required substantial financial and human resources. The eradication effort involved teams of researchers to develop the vaccine; teams of production and manufacturing workers; supply chain workers who moved products to affected areas; and then teams of public health workers surveilling, quarantining, and treating patients in the field. The active MTC was triggered through an international health system that saw the opportunity to eradicate the planet of this disease. Some distance can therefore be covered in reconciling the concepts of an MTC and a national system of innovation, as the global health system, seen as an MTC, was the product of the alignment of national systems of innovation. The national systems of innovation model fits the smallpox eradication effort in that it involved a series of innovations in low cost production, shipment, and implementation that eventually afforded governments the opportunity to ensure that none of their populations would again be affected by smallpox. The national

systems of innovation worked together coherently as a unit, i.e., as an active MTC, when self-interests aligned and outcomes were not only efficacious but economically feasible.

A more recent case study illustrating the activation of an MTC can be seen with the Ebola epidemic in West Africa in 2015. The epidemic in West Africa was first identified by Doctors Without Borders in March 2015, yet it took another three months before the WHO officially labelled it an epidemic, by which time more than one thousand people had been killed by the virus. Once the WHO stepped in, massive amounts of medical technology and human resources were deployed. Vaccines, which had been in development with little visibility, came to the forefront, as did various other treatments for infected patients. The MTC was not activated through governmental or individual response to the crisis, but by the WHO, which allocated billions of dollars of medical technology and coordinated personnel in the surveillance, quarantine, and treatment of thousands of infected and at-risk patients in West Africa. As a result of the WHO's efforts, the Ebola epidemic was declared over in autumn 2015. The case is important because it not only illustrates the important role played by the MTC, but also how the complex was activated too slowly; subsequent reports made clear that the slow response resulted in up to 8,000 deaths from the virus. The MTC in its active form clearly rose to the occasion in ending the epidemic in West Africa, but the epidemic also showed that the timing of the MTC's mobilization was absolutely critical, an important policy lesson for the future.

One illustrative case study of the activation of a normally passive MTC is the movement around HIV/AIDS. In the 1980s, when HIV was first diagnosed and the initial pathways for treatment were clinically developed, funding sources for HIV/AIDS research and treatment were minimal. HIV/AIDS was seen as a disease that was relatively contained to the homosexual and drug-using population, rather than a widely pervasive condition. Through the 1990s, as the long

incubation period permitted the disease to spread significantly among both homosexual and heterosexual populations, the funding response for new technologies to combat the growing epidemic was still slow. It was the ACT UP campaign of the 1990s that eventually mobilised large numbers of patient populations, their family and friends, and caregivers and clinicians to begin a protest movement that led to extraordinary levels of funding when compared to the percent of the population that was infected with the virus. ACT UP and the associated movement in fact activated an MTC and prompted the corresponding health care system, which would never have funded such research, to develop treatments, technologies, and best practices and protocols to manage HIV/AIDS. Today, research is at a point where HIV has become more like a chronic condition, with some commentators even likening it to Type II diabetes. Without the intervention of ACT UP, the HIV/AIDS epidemic would clearly have reached a far greater scale than it has over the past twenty years. This case illustrates how the MTC interacts with the global health care system, moving from passive to active until an intervention is developed that stabilizes society in general and specific patient populations in particular.

Personal intervention is a particularly interesting aspect of how medical technological complexes operate and are activated. There are two significant case studies, involving the Bill and Melinda Gates Foundation and the Clinton Foundation. The Bill and Melinda Gates Foundation, launched in 2000, was created as a means to improve global society. With an endowment of over forty billion dollars, the Gates Foundation has already contributed more than five billion dollars to the global health care system. One of its primary means of intervention has been the implementation of methods of distribution of vaccines to children five years and younger as a means of reducing infant mortality from infectious diseases.<sup>158</sup> Over the past fifteen years, the global infant mortality rate has fallen from roughly fifteen million children aged 0-5 to

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<sup>158</sup> [www.gatesfoundation.org](http://www.gatesfoundation.org)

seven million annually in 2014. In other words, Bill and Melinda Gates have singlehandedly activated an MTC through a series of deft developmental, supply-chain, and implementation relationships. Their ability to navigate and manipulate elements of the MTC, whether they be manufacturers of medicines or national governments through which medical technology must move in order to reach its intended population, illustrates the extraordinary awareness and tenacity that two people can have.

One key distinctive purpose of the MTC is the *diffusion* of medical technology. The Bill and Melinda Gates Foundation case study is instructive in showing how diffusion is an essential element of their foundation's operating model. That model is motivated by improving global public health, comprising medical technology interventions in pharmaceuticals, clean water, and environmental restoration, and is driven by a cost-per-unit formula that ideally allows them to have the greatest impact through discreet funding. This clearly differentiates the MTC model from the NSI and SSI models; sustainability and self-perpetuation for the Gates Foundation is defined as diffusion, rather than economic development.

The Clinton Foundation is another revealing example of how a nonprofit foundation is able to activate an MTC that hitherto had not been focused on specific interventions in the global healthcare system. The foundation has been able to raise two billion dollars over the past fifteen years to fight infectious diseases around the world. In contrast to the Gates Foundation, the Clinton Foundation is not funded by the family's personal wealth. Rather, it is the celebrity of the Clinton family that enables the foundation to persuade national leaders, corporate executives, nonprofits, multilateral agencies, and other celebrities to implement interventions to improve health globally, specifically directed towards reducing rates for HIV/AIDS, tuberculosis and other infectious diseases. The personally charisma of Bill Clinton has been able not only to

manage the MTC, but steer it with extraordinary skill. Furthermore, this is another example of how the MTC reacts to and interacts with various global institutions.

#### **IV. The Diffusion of Medical Technology**

From the printing press to the computer and the first use of penicillin to the widespread use of vaccines, people have devised tools for ‘improving health, raising productivity and facilitating learning and communication.’<sup>159</sup> A human development report published by the United Nations Development Program in 2001 stated that, ‘Technological innovation is essential for human progress.’<sup>160</sup> Multilateral and global organizations perceive technological transformation going hand in hand with globalization. Given this, understanding and developing the best process for diffusing technology is extremely important.

Diffusion theories were first formulated in the 1930s, when scientists were studying how patterns of communication influenced crop yields.<sup>161</sup> Since then, technology diffusion has been treated by numerous scholars as a tool for analysing the adoption and spread of new technologies across populations.<sup>162</sup> Although several technology diffusion theories have emerged over the past 80 years, a number of which have been focused on medical technology, a unified theory of medical technology diffusion has yet to take shape. This section will discuss various models that have been developed to explain diffusion, those of George Basalla, Everett M. Rogers, Daniel Headrick, and Damian Miller.

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<sup>159</sup> S. Fukuda-Parr, *Human Development Report 2001: Making New Technologies Work for Human Development* (New York, 2001), p. 27.

<sup>160</sup> S. Fukuda-Parr, N. Birdsall, S. Jahan, H. Fu, O. Noman, and K. Raworth, *Human Development Report 2001: Making New Technologies Work for Human Development* (New York, 2001), p. 27.

<sup>161</sup> A.L. Greer, ‘Advances in the Study of Diffusion of Innovation in Health Care Organizations’, *The Milbank Memorial Fund Quarterly: Health and Society* (55)4 (1977), pp. 505–32.

<sup>162</sup> Umar Ruhi, University of Ottawa, Canada; Sitwat Langrial, University of Oulu, Finland.

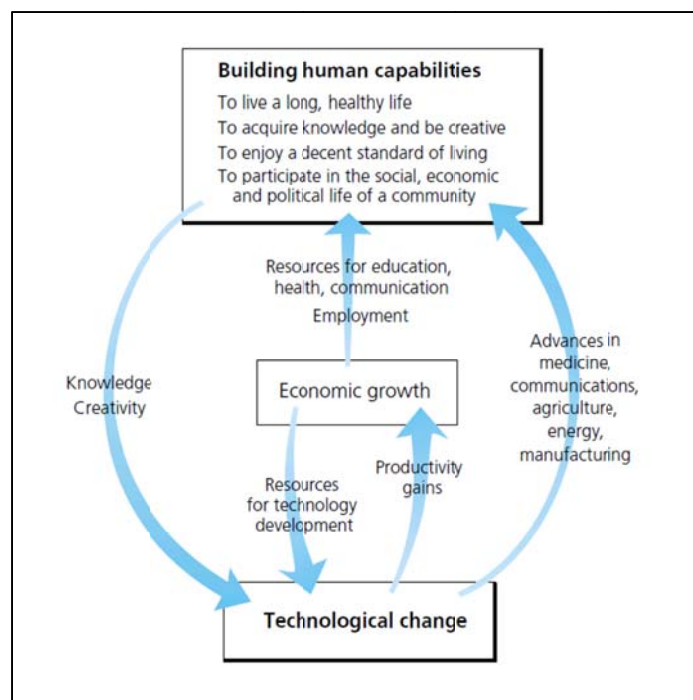


Figure 1: The relationship between technology, which is the application of science in society, and public health, from the United Nations Development Programme's perspective<sup>163</sup>

One of the most frequently cited historical models on the spread of Western science and technology is that of Professor George Basalla, first published in 1967.<sup>164</sup> Basalla explained how modern science diffused from Western Europe to the rest of the world using a tri-phased model:

Three overlapping phases or stages constitute my proposed model. During "phase 1" the non-scientific society or nation provides a source for European science. The word non-scientific refers to the absence of modern Western science and not to a lack of ancient, indigenous scientific thought of the sort to be found in China or India; ... "Phase 2" is marked by a period of colonial science, and "phase 3" completes the process of transplantation with a struggle to achieve an independent scientific tradition (or culture).<sup>165</sup>

The first stage was characterized by 'geographical exploration' and 'appraisal of natural resources' by Western Europe of nations such as India and China that have 'indigenous scientific

<sup>163</sup> *ibid.*, p. 28.

<sup>164</sup> G. Basalla, 'The Spread of Western Science', *Science*, 156 (3775) (1967), p. 611.

<sup>165</sup> *ibid.*

traditions'. This exploration is motivated by the prospect of trade and settlement. The second phase is described as 'colonial science' or 'dependent science.' The developing nation relies on another nation's established scientific culture by receiving training in European institutions or studying works of European scientists. During this phase, the developing nation takes advantage of established scientific traditions whilst developing its own science foundation.<sup>166</sup> During the third stage, scientists of the developed nation struggle 'to create an independent scientific tradition.'<sup>167</sup> The small group of scientists, most of whom were educated overseas, is replaced by scientists who trained at home and are bestowed with honours by native scientific organizations or the government. Completing the narrative, the developing country has now embraced the technology, spreading it on its own accord.

Basalla also listed the factors that must be present for what he described as 'a colonial, dependent scientific culture' to be transformed into an independent one.<sup>168</sup> These include overcoming the resistances to modern science within the developing nation based on religious and philosophical beliefs; social respect for the scientist and his labour; financial support for science by governments, including, education; the founding of native scientific organizations; the facilitation of communication of the science, and the maintenance of a certain level of technology sufficient to produce the equipment necessary for research and training.<sup>169</sup> Basalla stated that any nation able to master the above factors and successfully complete the three phases would emerge as a leader of world science.<sup>170</sup> He also described his model as being applicable to any historical set of circumstances.

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<sup>166</sup> *ibid.*, pp. 612–14.

<sup>167</sup> *ibid.*, p. 617.

<sup>168</sup> *ibid.*

<sup>169</sup> *ibid.*, pp. 617–18.

<sup>170</sup> *ibid.*, p. 620.

Whilst his model has developed over the last forty years, many historians, including Arnold, have criticized it as overly simplistic.<sup>171</sup> Gyan Prakash agrees with Arnold, arguing that the three-step model of the spread of the creation of technology in a host country did not take into account its ‘informal’ percolation into colonised societies and the transformation of science and technology by local stakeholders.<sup>172</sup> Additional criticisms of Basalla’s model have come from Deepak Kumar and Pratik Chakrabarti. Kumar argued that the movement from exploration to dependence to independence is not the straightforwardly linear process described by Basalla’s model.<sup>173</sup> Chakrabarti, meanwhile, is perhaps more sympathetic to Basalla’s model, but argues that the journey from dependence to independence depicted in the second and third stages is not necessarily a movement from centre to periphery.<sup>174</sup> Chakrabarti’s own model recognizes the value of the data collected and shared from the rural areas, and the exchange of value that took place between the centre and the periphery.<sup>175</sup>

Another historical model was created by the social philosopher, Everett M. Rogers, whose 1962 book *Diffusion of Innovations* provides a sociological analysis of innovation adoption across large populations.<sup>176</sup> His treatment of healthcare and medicine was unique in that it looked across a number of different stakeholders within the medical community. He based his definition of diffusion on the results of his studies conducted on the growth of military technologies in the USA in the 1950s and ‘60s. When looking at the diffusion of innovations derived from pharmaceutical firms, he first examined the communication practices of physicians

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<sup>171</sup> Arnold, *Science, Technology and Medicine in Colonial India*, p. 9.

<sup>172</sup> G. Prakash, ‘Science, Technology and Medicine in Colonial India (review)’, *Victorian Studies*, 45 (1) (2002), p. 150; G. Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton, 1999).

<sup>173</sup> J.B.D. Gupta (ed.), *Science, Technology, Imperialism, and War*, (New Delhi, 2007), p. 90.

<sup>174</sup> P. Chakrabarti, *Western Science in Modern India: Metropolitan Methods, Colonial Practices* (New Delhi, 2004), p. 16.

<sup>175</sup> *ibid.*

<sup>176</sup> E.M. Rogers, *Diffusion of Innovations*, 5th ed. (New York, 2003).

and hospitals, before looking at the National Institute of Health as a source of medical technology diffusion.<sup>177</sup>

Rogers defined diffusion as ‘the process by which an innovation is communicated through certain channels over time among the members of a social system.’<sup>178</sup> Since, as he noted, ‘individuals in a social system do not all adopt an innovation at the same time’, he outlined five different adopter categories: innovators, early adopters, early majority, late majority, and, finally, laggards.<sup>179</sup> Innovators are usually willing to assume risks and are interested in ideas; therefore they are the ones who introduce the new science or medical technology to the local area. Early adopters are respected persons in a locality to whom others look in order to determine which ideas introduced by the innovators will be adopted. The early majority consists of one-third of the local area, who tend to deliberate before adopting a new idea, but nevertheless constitute an important link in diffusion.<sup>180</sup> The late majority also makes up one-third of the population who, due to their sceptical nature and limited resources, adopt a new idea only after many others have done so.<sup>181</sup> Finally, the laggards are those traditionalists who are the last to adopt an innovation.<sup>182</sup> Socioeconomic status, personality values, and communication behaviour are factors that affect the diffusion category to which a person will belong.<sup>183</sup> Rogers’ five adopter categories can help individuals leading change or diffusion of technology understand how to reach different segments of the population.

In addition to the five different adopter categories, Rogers also outlined five attributes of innovations that affect how quickly an innovation is adopted: relative advantage, compatibility,

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<sup>177</sup> *ibid.*

<sup>178</sup> *ibid.*, p. 11.

<sup>179</sup> *ibid.*, pp. 267, 280.

<sup>180</sup> *ibid.*, pp. 282–4.

<sup>181</sup> *ibid.*, p. 284.

<sup>182</sup> *ibid.*

<sup>183</sup> *ibid.*, p. 287.

complexity, trialability, and observability.<sup>184</sup> He defined relative advantage as ‘the degree to which an innovation is perceived as being better than the idea it supersedes.’<sup>185</sup> If the new idea is perceived as better, there will be a better rate of adoption. An innovation also has to be compatible with the existing values and needs of society and easy to understand or use to have a high rate of adoption.<sup>186</sup> Further, adoption will be more rapid if an innovation can be experimented or tried on a limited basis by a social system.<sup>187</sup> Finally, an innovation has a better rate of adoption if it is observable to members of a social system.<sup>188</sup>

Scholars over the last fifty years have refuted aspects of Rogers’ work. In her 1977 article on medical technology innovation, sociologist Anne Lennarson Greer argued that the classical theory does not address the social consequences within medical technology innovation.<sup>189</sup> John McKie, meanwhile, has argued that a diffusion theory must address the various uses of technology in developing countries, something that Rogers’ model fails to account for.<sup>190</sup> McKie’s article explained that medical technology developed in the West instantiates and reflects the prevalent culture of those nations, and can thus meet with substantial resistance in indigenous cultures and developing healthcare systems.<sup>191</sup> In 1989, Anne Bonair noted that, ‘technologies are still seen as major levers for social change, particularly if they include opportunities for the development of skills to modify those technologies for local use’.<sup>192</sup>

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<sup>184</sup> *ibid.*, p. 221. In a 2004 article, the five attributes of innovations were applied to telemedicine. N. Menachemi, D. Burke, and D. Ayers, ‘Factors Affecting the Adoption of Telemedicine’, *Journal of Medical Systems* (28) 6 (2004), pp. 617–22.

<sup>185</sup> Rogers, *Diffusion of Innovations*, p. 229.

<sup>186</sup> *ibid.*, pp. 240, 257.

<sup>187</sup> *ibid.*, p. 258.

<sup>188</sup> *ibid.*

<sup>189</sup> A. L. Greer, ‘Advances in the Study of Diffusion of Innovation in Health Care Organizations’, p. 528.

<sup>190</sup> J. McKie, ‘Management of Medical Technology in Developing Countries’, *Journal of Biomedical Engineering* 12 (1990), p. 260.

<sup>191</sup> *ibid.*

<sup>192</sup> A. Bonair, P. Rosenfield, and K. Tengvald, ‘Medical Technologies in Developing Countries: Issues of Technology Development, Transfer, Diffusion and Use’, *Social Science and Medicine* 28 (8) (1989), p. 770.

As noted earlier, one historian who has written extensively on the spread of Western technology is Daniel Headrick, who has been concerned with what he describes as the ‘massive transfer of technology from the West to Africa and Asia.’<sup>193</sup> Headrick pointed out that no theory has yet emerged to encompass all of the processes associated with diffusion, arguing that the transfer of technology consists of two processes. The first is relocation from one point to another of various types of tools and the technicians who would need to deploy them. The second is the diffusion of various cultural attitudes, training, and education from one country to another. By separating these two processes, Headrick wanted to distinguish between geographic diffusion and cultural diffusion.

Headrick also discussed the individuals responsible for the spread of Western science technology. He listed three transfer agents: the exporters, the importers and the migrants.<sup>194</sup> The exporters consists of individuals such as sales people, various aid officials and others who worked for the technology companies. The second agent, known as importers, included ‘students, purchasing agents and spies.’ They were the advocates of technology diffusion. The migrant is the person actually moving from one country to another and, in so doing, spreading the various types of science and technology. He cited seventeenth-century Huguenots and nineteenth-century immigrants to America as migrant agents of technology transfer.<sup>195</sup>

Another model was proposed by Damian Miller, who mapped out several theories related to the diffusion of innovations in a 2000 article. In his piece, Miller stratified the different perspectives on technology and diffusion. Placing them in a table, he broke the theories down by perspective, discipline, basic assumption, unit of analysis, and factor of significance. Miller’s

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<sup>193</sup> Headrick, *The Tentacles of Progress*, p. 154.

<sup>194</sup> *ibid.*

<sup>195</sup> *ibid.*

table (see below) provides both a summary of theories of technology diffusion and a method to isolate differences in the theories themselves.

A summary of perspectives on technology diffusion					
Perspective	Discipline	Basic assumption	Unit of analysis	Factor of significance	Process
Communication perspective	Rural sociology, communication studies, geography, marketing	Majority of individuals are risk averse	The adopter	Adopters' uncertainty and perceived risks/benefits of adoption	Uncertainty reduction; particularly through referencing
Economic history perspective	Economic history, public policy	Individuals are rational economic agents	The new and old technology	Declining costs and improved performance of the new versus old technology	Technological problem-solving
Development perspective	Economics, development studies, agricultural economics	Unequal distribution of resources in society	The adopter	Adopters' relative purchasing power	Access to resources, particularly money and credit
Market infrastructure perspective	Geography	Opportunity to adopt is unequal	The diffusion agency	Availability of the new technology	Diffusion agency establishment and actions

Table 4: Miller's Table Summarizing Technology Diffusion Models<sup>196</sup>

Although the diffusion models discussed above are helpful, they do not address the importance of various stakeholders that affect the development, production, and distribution of medical technologies throughout the emerging public health systems in developing countries. In the preface to the latest edition of his classic work, Rogers states that, 'In studying the diffusion of innovations in developing nations, I (and others) gradually realized that certain limitations existed in the diffusion framework.'<sup>197</sup> This thesis will develop these diffusion theories by discussing the influence of stakeholders in diffusion. The various stakeholders were very

<sup>196</sup> D. Miller and E. Garnsey, 'Entrepreneurs and Technology Diffusion: How Diffusion Research Can Benefit from a Greater Understanding of Entrepreneurship', *Technology in Society*, 22 (2000), p. 449.

<sup>197</sup> E.M. Rogers, *Diffusion of Innovations*, p. 19.

important to the diffusion of medical technology. i.e. life-saving medicines and medical devices, in India.

## **V. A Discussion of the Demand Side Factors Found in Statistical Material**

Between 1947 and 1991, a number of elements converged to spur the growth of the Indian medical technology complex. One of the most important elements was demand, both foreign and domestic, for Indian pharmaceuticals and medical technology devices. What follows is a statistical overview that illustrates the demand side of India's burgeoning medical technology complex.

The three areas that best illustrate the increased demand for medical technology within India from 1947 to 1991 are the use of antibiotics, vaccinations, and family planning controls. Whilst this work has primarily explored the supply side of the medical technology growth during this period, many of the stakeholders in the medical technology complex, including public health agencies, foundations, and multi-national corporations (MNCs), were also working to build demand for these products. Their aim was to improve patient care whilst also meeting their secondary objectives, viz., stabilizing democratic regimes, meeting the goals of family trusts, and generating profits for shareholders.

In her work on pharmaceuticals in India, Smita Srinivas argues that the Indian government's expanded coverage for these drugs following the Patents Act of 1970 spurred key stakeholders to meet the increased demand for these technologies in the public health sector. This specifically included antibiotics and vaccinations; MNCs, she wrote, "have attempted to hold on to older public health niches (antibiotics, vaccines, diagnostic kits) with newer

technologies and sustained compliance with US FDA standards.”<sup>198</sup> With price reductions for many of these basic treatments in place, substantial demand for antibiotics and vaccines was created. This, in turn, was pivotal to India’s medical technology growth because it provided a domestic customer base that, at minimum, would cover the annual operating costs of the nation’s businesses.

Much of the growth in other areas of India’s medical technology complex, particularly in the 1970s and ‘80s, was linked to internal demand. One area that saw an increase in demand, albeit one less than in other major Asian economies, was family planning. Family planning was stigmatized by many religious and cultural elements in India, but this opposition declined over the years, as Western medical technology and practices became more widespread and acceptable. In Table 1 below, we see a secular trend, i.e., a decrease in total fertility rates measured by the average number of births per female from 1950 to 2007.<sup>199</sup> The fertility rates of most relevance to the present project are those from 1950 to 1990. Comparing India to nine other major Asian

	1950	1960	1970	1980	1990	2000	2005	2007
China	6.24	5.93	4.76	2.68	2.10	1.89	1.60	1.60
Hong Kong	4.43	4.97#	3.49	2.06	1.27	1.04	1.00	1.00
Indonesia	5.49	5.42	5.10	4.10	3.04	2.42	2.60	2.40
Korea (South)	5.18	5.60	5.24	4.02	1.77	1.47	1.20	1.10
Malaysia	6.83	6.72	5.15	3.91	3.77	2.96	3.30	2.90

<sup>198</sup> Srinivas, ‘Technological Learning’, p. 205.

<sup>199</sup> Keyfitz and Flieger 1990; Population Reference Bureau (see [http://www.prb.org/datafind/datafinder.htm\[sic\]](http://www.prb.org/datafind/datafinder.htm[sic])); World Bank, World Development Indicators Online (see <http://www.worldbank.org/data/wdi2004/index.htm>); CIA World Factbook (see <http://www.cia.gov/library/publications/the-world-factbook/>)

Singapore	6.41	5.43###	3.10	1.74	1.87	1.44	1.30	1.30
Taiwan*		5.79	4.00	2.51	2.27	1.76	1.20	1.10
Thailand	6.62	6.42	5.01	3.52	2.10	1.86	1.70	1.70
India	5.97	5.81	5.43	4.75	3.80	3.07	3.00	2.90
Japan	3.30**	2.01	2.07	1.74	1.54	1.36	1.30	1.30
France	2.86**	2.80#	2.48	1.95	1.78	1.88	1.90	2.00
Germany (West)	2.10	2.41	2.01	1.46	1.45	1.38	1.30	1.30
Italy	2.40	2.42#	2.38	1.64	1.26	1.24	1.30	1.40
United Kingdom	2.18	2.82	2.45	1.89	1.83	1.64	1.70	1.80
United States	3.08	3.65	2.47	1.84	2.08	2.06	2.00	2.10

Table 5: Secular Trends in Total Fertility Rates<sup>200</sup>

economies, including China, Korea, Malaysia, and Japan, it is clear that the medical technology in the field of birth control grew, but at a slower rate than that of other major Asian economies.

Further evidence for the demand for family planning medical technologies from 1951 to 1990 was provided by Imrana Qadeer in the *Journal of Public Health Medicine*.<sup>201</sup> Table 5

<sup>200</sup> R.W. Fogel, 'The Impact of the Asian Miracle on the Theory of Economic Growth', in D.L. Costa and N.R. Lamoreaux (ed.), *Understanding Long-Run Economic Growth: Geography, Institutions, and the Knowledge Economy*, Chicago, University of Chicago Press, 2011, pp. 311-354.

clearly shows the massive expansion in the demand for these technologies as India grew from an imperial nation to independence, and indicates the extent to which the postcolonial government promoted these technologies as part of the modernization of India. The medical technology complex in India was therefore spurred not only by export demand from communist and capitalist nations, but also from domestic demand.

Sub-sectors	1951-56 Plan I	1956-61 Plan II	1961-66 Plan III	1966-69 Annual	1969-74 Plan IV	1974-79 Plan V	1980-85 Plan VI	1985-90 Plan VII	1992-97 Plan VIII
Control of communicable diseases	231.0 (16.5)	640.0 (28.4)	690.0 (27.7)	231.0 (10.2)	1270.0 (11.1)	2681.7 (11.5)	5240.0 (27.0)	10126.7 (7.7)	10450.0 (4.2)
Total health	903.0 (64.5)	1460.0 (64.9)	1500.0 (60.2)	939.0 (41.6)	4335.0 (37.5)	7962.0 (34.1)	18211.0 (27.0)	33928.9 (25.8)	75759.5 (30.5)
Family planning	7.0 (0.5)	30.0 (1.3)	270.0 (10.8)	829.0 (36.7)	3150.0 (27.3)	5160.0 (22.1)	10100.0 (15.0)	32562.0 (24.7)	65000.0 (26.0)
Water supply and sanitation	490.0 (35.0)	760.0 (35.3)	720.0 (28.9)	490.0 (21.7)	4070.0 (35.2)	10220.0 (43.8)	39220.0 (58.0)	55970.0 (50.5)	107430.3 (43.0)
Grand total of health + family welfare + water supply and sanitation	1400.0	2250.0	2490.0	2258.0	11555.0	23342.0	57530.0	131716.5	248189.8

Figures in parentheses are percentages of grand total, except for communicable diseases, which is per cent of total health. Source: respective Five Year Plans of the Government of India, Planning Commission.

Table 5: Intrasectoral financial allocations for health sector (millions of rupees)

The increased demand for medical technologies related to family planning in India is indicative of a nation undergoing a cultural as well as an industrial revolution. The demand for family planning technologies suggests that generations of women during this period were using such technologies to assert control over their reproductive rights. They were also fighting to receive an education and join the work force, opportunities that were not previously afforded to them.

The effects of the regulatory system, in particular the Patents Act of 1970 and the Drug Price Control Order of 1970, cannot be ignored. The critical event was introduction of a new price control structure based on the idea that following the 1970 Act, patents were concerned

<sup>201</sup> I. Qadeer, 'Health Care Systems in Transition III. India, Part I. The Indian Experience,' *Journal of Public Health Medicine*, Vol. 22, No.1 (2000), pp. 25-32.

solely with process, not chemical composition. The table on page 178 of the Hathi Report analyses the profitability of 42 pharmaceutical companies from 1968 to 1973. The analysis showed that the net worth of these companies increased substantially, as did net sales and profits. The net worth of these companies rose 15% in the period 1968-70, but rose 30% in the period from 1970 to 1972. Net sales and net profits increased by similar degrees. This table suggests that, far from the new patent regime having a detrimental effect on the pharmaceutical industry, the profitability of the industry continued to rise at healthy rates following its introduction.

The dramatic, sometimes reactionary changes in regulatory policy are critical to understanding the broader effect of the regulatory nature of the intellectual property regime. The increase in regulation resulting from the two 1970 laws was meant to increase access to vital medical technologies and pharmaceuticals by lowering prices, thereby spurring a growth in the volume of sales. The ultimate goal of the government – increasing access whilst maintaining the vitality of the pharmaceutical industry – was not only met, but exceeded. As the Hathi Report demonstrates, although the net worth, sales, and profit all continued to rise at vigorous rates, the ratio of net profit to net sales actually declined, from 8.25 in 1970 to 5.83 in 1973. This number represents the amount of money a company receives on a per-customer basis, and the decline shows that their per-unit profit for each customer was restricted. The Indian government's agile economic policy and political adaptability was good for patients and business alike.

Further analysis of the Hathi Report yields additional statistical data regarding the development of demand, both domestic and international, as prices dropped. In the case of domestic demand, on page 43, the committee aggregated a series of sulphur drugs used for antibiotics. The use of sulfadimidine is shown to have nearly tripled in the three years following the passage of the Patents Act. Most standard products such as quinine, as well as a broad

category called ‘other antibiotics’, rose nearly 300%. The growth of the external market was seen primarily in secondary countries that were less concerned about enforcing the international patent law norms transgressed by the Patents Act. Although the Patents Act alienated a handful of developed countries, it had the net effect of increasing the production and distribution of domestic pharmaceuticals. In the long term, this would not only benefit the pharmaceutical industry itself, but also ancillary biomedical industries.

Additionally, the Hathi Report demonstrates a dramatic decline in the volume of pharmaceuticals being imported into India. This was clearly a response to the price cuts that followed the Patents Act and the Drug Price Control Order: foreign firms did not have the low-margin cost structure of domestic companies in India, so it was impossible for them to continue to supply pharmaceuticals after the mandated price drops. This drop in supply further fuelled the demand for domestic manufactures.

Understanding how demand has driven the growth of the pharmaceutical industry in India requires an understanding of supply, a term that indicates efforts to increase product supply through private capital investment and decrease barriers to the production of these products. Within the Indian economy from 1947 to 1991, we see increased demand side factors through the 1970s and 80s, particularly through the pre-liberalization movement in 1985. In other words, the stage had been set for the growth that followed liberalization in 1991, as the domestic markets had already been developed by that time.

#### **IV. Conclusion**

This comprehensive, chapter-length literature review has engaged a series of empirical works that will allow the reader to grasp current thinking about not only the history of the Indian

medical technology and life sciences industry, but also the theoretical context from which it has evolved. It has also provided a statistical review illustrating the demand of the Indian pharmaceutical industry, of which more tables are listed in the appendix for further empirical evidence to this point. It has begun to frame a key questions that the next 6 chapters will attempt to address. The primary question that this work will attempt to answer is how a poor country on the verge of collapse at independence could emerge as a leader in the global life science industry in fifty years? Additionally, the thesis will attempt to provide lessons for other industries in India, and for public policy and corporate healthcare and life science planners in other emerging countries.

## Chapter 2: The State of Medical Technology at the Moment of Indian Independence –

August 1947

‘If it were possible to evaluate the loss, which this country annually suffers through the avoidable waste of valuable human material and the lowering of human efficiency through malnutrition and preventable morbidity, we feel that the result would be so startling that the whole country would be aroused and would not rest until a radical change had been brought about.’<sup>202</sup>

– *Report of the Health Survey and Development Committee*, Vol. II, 1946

For decades prior to the end of imperial rule in August 1947, India’s medical technology capabilities had been primarily dictated by the needs of the British Empire, a trend that dated back to the first British presence in the eighteenth century. By examining the roots of India’s medical technology prior to independence – including its natural resources, educational institutions, scientific networks, and medical infrastructure – this chapter will establish the base from which it began its long and peripatetic journey to becoming a world leader in medical technology.

The chapter begins by reviewing the general condition of the nascent Indian state at the time of independence on August 15, 1947. A sampling of representative stories, ranging from sports to political reorganization provides a context for understanding the issues which commanded the attention of the Indian public in August 1947. The second section analyses the economic status of India in the period immediately prior to and following independence. The overwhelming majority of India’s sizable population during this period was barely at subsistence level, whilst a small group reaped the benefits of isolated instances of development that had emerged during World War II. The third section of the chapter will examine the state of healthcare in India on August 15, 1947 by using data provided by the *Report of the Health*

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<sup>202</sup> *Report of the Health Survey and Development Committee*, Vol. II (New Delhi, 1946), p. 10. Accessed 16 July 2014 at [www.nhp.gov.in/bhore-committee](http://www.nhp.gov.in/bhore-committee).

*Survey and Development Committee*. The fourth section will focus on the state of medical education and the steps India was taking to make improvements in this critical field. The fifth section discusses India's natural resources, which significantly aided its tremendous growth in medical technology. The sixth section will review the state of India's medical technology at the moment of independence. Finally, the effect on the Indian economy of certain government policies, like taxation, will be analysed.

### **I. British India on the Eve of Independence**

On August 14, 1947, India was on the brink of achieving independence. The political and social upheaval that would soon follow the partitioning of the subcontinent became one of the most significant events of both mass violence and human migration in world history. But on the final day of Imperial rule, most accounts in the press suggested that the move to create an independent India and partition the subcontinent would be relatively smooth. The 'business as usual' stories published that day assured readers that life in India was normal and would continue to be so following independence. Faced instead with a country torn apart by violence, the policy priorities of India's new government reflected the need to establish religious harmony, develop a strong state, and rebuild much of the infrastructure that was destroyed following the Indo-Pakistani War of 1947-48.

The News reports in the days immediately before independence focused on the everyday experience of life in India, including continuities with life under British rule, rather than pointing toward the momentous events on the horizon. One of the major news items reported on August 14<sup>th</sup> concerned the resignation of Vijay Merchant, the venerable captain of the Indian cricket team, on the eve of India's tour of Australia due to injury. During an interview with the *Times of*

*India*, Merchant admitted ‘that for a long time he has been suffering from severe strain on a nerve in the lower abdomen and all the medical treatment has proved of no avail.’<sup>203</sup> It was also reported that India’s new ambassador to the Soviet Union aimed to complete her move to Moscow in the coming month, noting that she ‘hopes to move in there within the next few days with her daughter. It is thought unlikely that she will be in formal residence there by August 15, when there will be a quiet celebration there of Indian Independence Day.’<sup>204</sup> This report on the minutiae of diplomatic life offered little hint of the tumult to be visited upon India and Pakistan over the coming months.

Much as in the fields of sport and diplomacy, August 14, 1947 proved to be business as usual for India’s healthcare system. The *Times of India* reported that the regions of Gujarat and Kathiawar had introduced a scheme for improving the administration of schools, medical relief, and public roads, as well as police and judicial arrangements.<sup>205</sup> These measures, it was hoped, would allow for the local integration of public administration and healthcare and the attendant transfer of control from central to regional government. It was reported that,

A “COMMUNIQUE” from the State Department tonight announced the termination of the four-year-old’ [sic] attachment scheme’, affecting some 327 talukas and thanas in Gujerat nd [sic] Kathiawar, and new arrangements for their future administration, which include the appointment by the Dominion Government of a Regional Commissioner with headquarters at Rajkot.<sup>206</sup>

It appears that the pre-independence government viewed the localization of power through a new administrative arrangement as a way to affect a smoother transition to independence. Thus, although the new governmental bodies – state and local – were preparing for the advent of

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<sup>203</sup> ‘Vijay Merchant Not Going to Australia; Ill-Health Compels India’s Skipper To Relinquish Post,’ *Times of India*, 14 Aug. 1947, p 1.

<sup>204</sup> ‘Mrs. Pandit at Kremlin’, *Times of India*, 15 August 1947, p 5.

<sup>205</sup> ‘Gujerat & Kathiawar Scheme of Attachment Ends’, *Times of India*, 14 August 1947, p. 1.

<sup>206</sup> *ibid.*

independence, they apparently did not foresee the extent of the violence and political upheaval that would follow.

The prevailing ‘business as usual’ attitude was also evident in the territory that would come to comprise Pakistan. The major news event emerging from these provinces on August 14 was the eleventh-hour change to its leadership being made by Pakistan’s first cabinet: ‘A last-minute decision appears to have been taken at a conference at Government House this evening to drop Mr. Suhrawardy and in his place include Mr. Fazal Rehamn, at present Minister in the Bengal Cabinet.’<sup>207</sup> This kind of political shuffling was thought to create a more stable independent government and was a natural course of action to pursue in the days immediately preceding the swearing-in of a new government; in hindsight, it is evident that such piecemeal changes to the government did little to ward off the violence that ensued.

Whilst nearly all of the news accounts focused on the nuances of daily life, a review of the *Times of India* in 1946 and 1947 suggests that riots, although comparatively small in scale, were not unusual occurrences in Imperial India. In fact, exactly one year before independence, on August 14, 1946, a small riot occurred in Faiz Bazaar in Delhi in which 12 people were injured and six others were taken to the hospital.<sup>208</sup> And such events continued to take place even as the Imperial government lived out its final days of rule in India.

Given that riots and disturbances of the peace occurred with a fair degree of regularity in this period, some violent outbreaks should have been expected in the days leading up to independence. Indeed, on August 14, 1947, the *Times of India* reported an exchange of gunfire that resulted in the death of a Rampur State police officer; the incident occurred after ‘Rampur State Police cordoned off Chunni, the ring leader of the *goondas* [hired gangs], and some of his

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<sup>207</sup> ‘Pakistan’s First Cabinet: Eleventh-Hour Change’, *Times of India*, 14 August 1947, p. 1.

<sup>208</sup> ‘Late News’, *Times of India*, 14 August 1946, p. 1.

followers, in an orchard outside the city.’<sup>209</sup> That same day, riots broke out in Alwar town, with ‘more than 100 Persons [...] killed or injured in a communal riot at Tijara [...]. Machine-guns and rifles were freely used in the riot by the malefactors.’<sup>210</sup> The article continued to say that many women had been abducted, shops were looted, and that ‘fires blazed unchecked in Lahore throughout last night in various sectors’. Although the situation had improved by the afternoon, 26 fires had been set throughout Lahore and around 50 people were fatally stabbed.<sup>211</sup>

Perhaps the clearest sign of the trouble that would emerge in the coming months was the well-known incident that occurred at Mahatma Gandhi’s home in Calcutta.<sup>212</sup> In the hours immediately prior to India’s independence, Gandhi had taken up residence in a Muslim area of Calcutta.<sup>213</sup> It was reported that Gandhi:

abandoned his usual evening prayers today when a hostile mob, a thousand strong, staged a demonstration in front of his house in Beliaghata, where he had shifted this afternoon from Sodepur, in accordance with his agreement with Mr. H.S. Suhrawardy to live in a riot-affected area, so as to restore peace in the city.<sup>214</sup>

As the crowd entered the compound and overtook the house, Gandhi appeared at a window, prompting the crowd to immediately abate its chanting. Gandhi declared that he would move from his residence if his presence was upsetting the crowd. In response, the crowd quickly retreated. That a threat to the safety of the figurehead of Indian independence could take place a mere two days before independence shows how volatile the religious and political situation across the subcontinent was becoming. In hindsight, tension surrounding the person who most

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<sup>209</sup> ‘“Goondas” Fire on Police’, *Times of India*, 14 August 1947, p. 7.

<sup>210</sup> ‘Riots Break Out in Alwar Town’, *Times of India*, 15 August 1947, p. 16.

<sup>211</sup> *ibid.*

<sup>212</sup> ‘Mr. Gandhi’s House Stoned By Mob’, *Times of India*, 14 August 1947, p. 1; S.A. Wolpert, *Gandhi’s Passion: The Life and Legacy of Mahatma Gandhi* (Oxford, 2001), pp. 7–12; D. Dalton, *Mahatma Gandhi: Nonviolent Power in Action* (New York, 1993), pp. 150–153.

<sup>213</sup> ‘Mr. Gandhi’s House Stoned By Mob.’

<sup>214</sup> *ibid.*

embodied India's independence proved to be the most accurate portent of the terror that would quite literally rip the land apart in the months to come.

As this story clearly indicates, political polarization was on the rise in the years leading up to 1947, resulting in communal violence and the formation of extremist organizations that created mythical 'national' identities. Communalism grew from secular leaders of political parties who sought to further their own interests.<sup>215</sup> Throughout India's history pluralism was 'a way of life': many 'castes, classes, creeds, sects, languages, regions, and cultures' that co-existed.<sup>216</sup> In feudal times, Indians had co-existed in peace since there was no competition between them.<sup>217</sup> However, the British presence changed this dynamic with their divide and rule policy.<sup>218</sup> The socio-cultural, economic, and political differences between Hindu and Muslim elite began to emerge changing the path of India's future.<sup>219</sup> Communalism led to the Partition and to political turmoil: it would become a marker for the next 50 years of Indian independence.

## **II. A Tale of Two Indias**

The British government provided the Indian subcontinent with a highly detailed record keeping, demographics and ethnic background. The last census prior to independence, conducted in 1941, recorded a total population of 389 million; by 1947, the estimated population was 400 million,<sup>220</sup> predominantly spread across four communities: Hindus, Muslims, and Sikhs. Of these, Hindus dominated the country, totalling approximately two-thirds of the population as a whole. Muslims comprised the second-largest ethnic group, with roughly one-quarter of the population, and

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<sup>215</sup> V. Shukla (ed.), *Communalism in India* (Gurgaon, 2008), p. 15.

<sup>216</sup> *ibid.*, p. 13.

<sup>217</sup> *ibid.*, p. 36.

<sup>218</sup> *ibid.*, p. 38; S.S. Janjua, 'Communalism in India', *Social Policy and Administration in India* (1996), p. 201.

<sup>219</sup> Shukla, *Communalism in India*, p. 38.

<sup>220</sup> W.W. Ehrmann, 'Post-War Government and Politics of India', *The Journal of Politics*, 9 (4) (Nov. 1947), p. 656.

dominated both the north-western and eastern regions of India in the Bengal area. India's largest city at the time was Calcutta, with an estimated 2 million inhabitants.<sup>221</sup>

Much like the country's ethnic divisions, the state of India's economy in the days before August 15, 1947 is a study in contrasts.<sup>222</sup> Although India boasted one of the largest populations on the planet, its individual wealth levels, particularly as measured on per capita income levels, were very low. According to best estimates from economists, the rupees per annum at 1946–47 prices hovered between 163 and 166.<sup>223</sup> This was down from the 1940 figure, which hovered around 169 rupees per year, and even that number was not the all-time high, which occurred in 1930, when the annual per capita income in 1946–47 prices was 171 rupees per year. In fact, the per capita income in 1946–47 prices remained relatively consistent from 1868–1945.<sup>224</sup> India's stagnation across several generations reflected major structural defects in its economy. Moreover, alongside such poverty there also existed a much smaller group, which had been enriched by the wartime development of the country and was looking for new markets at home and abroad.

India's wider economic stagnation has been linked to three key bottlenecks in economic development. The first was a shortage of savings for investment, which meant that Indians were unable to save money and hence directly invest in domestic products. The second was a dependence on imported food to feed the domestic population. And the third was a lack of foreign exchange, a situation that was in the interests of the British, who wanted to maintain sovereignty over the Indian exchange market.<sup>225</sup> These factors combined to produce a lack of income growth, the result of which was extreme poverty. Moreover, it meant that the number one

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<sup>221</sup> *ibid.*, p. 658.

<sup>222</sup> G.S. Balla, 'Peasant Movement and Agrarian Change in India', *Social Scientist* 11 (8) (August 1983), p. 39.

<sup>223</sup> D. Lall, *The Hindu Equilibrium* (New York, 2004), p. 147.

<sup>224</sup> *ibid.*

<sup>225</sup> R. Thakur, 'Restoring India's Economic Health', *Third World Quarterly* 14 (1), p. 138.

development issue within domestic Indian politics, both then and now, has been the eradication of poverty.<sup>226</sup> Whilst the effort to combat India's poverty is laudable and necessary, the combination of these three elements placed substantial downward pressure on one of India's most promising points of growth, medical technology.

However, the nation was not entirely bereft of economic activity. In fact, in an illustration of the two Indias, isolated parts of the nation were prospering in response to the events of World War II. The Allies' need for goods to support the wartime effort brought new investment to India, resulting in an unprecedented rise in production capacity.<sup>227</sup> Before the war, there had been hesitation by domestic and foreign businesses to engage in direct investment in India due to its dominance by Great Britain, as a result of which many foreign investors had little motivation to build up factories and services in the country. But WWII, impending independence, and the financial transparency that democracy was assumed to bring, led investors to look to India for business investments, providing an economic lift in jobs.<sup>228</sup>

After WWII, there was also a dramatic increase in India's manufacturing base. The steel industry, for example, was consolidating and growing at unprecedented levels due to post-WWII global rebuilding efforts. India's manufacturing base in chemicals also carried its wartime production levels into the post-war era, whilst entirely new manufacturing sectors also emerged, as *Barron's* noted:

The Portland cement industry, which produced 1,512,000 tons in 1939, now has an output of 2.5 million tons. These are but a few of the directions in which an exporter to

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<sup>226</sup> T.N. Srinivasan, 'China and India: Economic Performance, Competition and Cooperation: An Update', *Journal of Asian Economics*, 15 (2004), p. 614.

<sup>227</sup> A. Moore, 'India's Market for Industrial Goods Realistic Approach Could Build Sound, Profitable Exchange of Goods', *Barron's National Business and Financial Weekly*, 1 July 1946, p. 11.

<sup>228</sup> *ibid.*

India will find not only competition but perhaps even local sentiment against him. Indian industry is on the march.<sup>229</sup>

*Barron's* detailed account of India's pre-independence economy provides a rare glimpse into the state of the economy in the brief window between World War II and independence. The building blocks for India's inclusion in the medical technology complex, including fine chemicals and a market of emergent buyers, had developed during and immediately after World War II. Whilst the war gutted many of the world's leading manufacturing areas, it resulted in the expansion of most of India's industrial base. India developed a vibrant and stable manufacturing base with a solid domestic capacity in several critical areas for medical technology, such as chemicals and cement. However, as of July 1946, there were manufacturing areas that had not yet been tapped: 'As yet, India does not produce coal-tar, a fact which makes it necessary to import all fine dyes in pharmaceuticals.'<sup>230</sup> Furthermore, India was purchasing American medicines and other items in the medical technology area such as cosmetics and supplies.

David Arnold's article, 'Cycles of Empowerment? The Bicycle: An Everyday Technology in Colonial India and Vietnam', describes the growth of the bicycle market in India during the 1930's and '40s.<sup>231</sup> Arnold goes into great detail regarding the growing use of the bicycle in the latter part of nineteenth- and early twentieth-century India, providing evidence of how Western technology, once transferred to a developing nation, acquired its own social and economic support.<sup>232</sup> Arnold's article cites the socialization of 'everyday technologies' in India as a variation of Basalla's model of the spread of Western medicine and medical technology.<sup>233</sup>

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<sup>229</sup> *ibid.*

<sup>230</sup> *ibid.*

<sup>231</sup> D. Arnold and E. DeWald, 'Cycles of Empowerment? The Bicycle and Everyday Technology in Colonial India and Vietnam', *Comparative Studies in Society and History* 53 (4) (2011), pp. 971–96.

<sup>232</sup> *ibid.*, p. 971.

<sup>233</sup> *ibid.*

Arnold's evidence points, not only to the large scale industrialization of the bicycle and the creation of a new market within India, but more importantly to the process by which Western technology spread across new nations. After WWII, India's manufacturing base became self-sufficient in certain products: 'Before the war, light bulbs were made in India, but the glass shell came from Japan. Now the industry is entirely indigenous. [...] Bicycles came from Britain or Japan before the war; now they are made in India.'<sup>234</sup> The new markets that emerged in India during World War II, and the manufacturing base that it sustained, went beyond light bulbs and bicycles.

As a result of the preservation of its wartime industrial base, many Indian businesses sought to work with foreign firms in order to develop a domestic market for manufacturing medical technologies. This was, however, a more difficult task than had been expected, as Tyabji has noted:

Indian entrepreneurs ... were disappointed to find such collaboration unavailable except an exchange for part ownership in the new firms. With the experience of colonial subordination still vivid in their memories, this type of arrangement met with resistance from Indian industrialists.<sup>235</sup>

India's imperial experience made its companies wary of partnerships that did not guarantee them equal footing. As I will show in Chapter 3, following independence, the new government began placing strict controls and taxes on foreign goods imported into the Indian market.<sup>236</sup> The result of this policy was that the development of a domestic medical technology base in India would not occur for some time – and certainly not in the years between World War II and independence. Eventually, the combination of market demand and government support led to a

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<sup>234</sup> *ibid.*

<sup>235</sup> N. Tyabji, 'Gaining Technical Know-How in an Unequal World: Penicillin Manufacture in Nehru's India', *Technology and Culture*, 45 (2) (2004), p. 333.

<sup>236</sup> Moore, 'India's Market for Industrial Goods', p. 11.

vigorous development in medical technology; later chapters in this work will detail the specific policies that led to this dramatic *volte-face*. In the short term, however, the taxation of imported foreign goods had serious negative consequences: in the case of the manufacture of penicillin, for example, the government's hesitation resulted in the delay of medical technology development for several years following independence.

But this industrial growth, though significant, benefitted only a handful of Indians, further increasing the existing divisions within Indian society and creating an economic caste for much of India's future industrial power.<sup>237</sup> There are a number of reasons why India's industrialization was not spread more consistently across the country. Most significant was the remnants of India's feudal political system, which saw the nation divided into a number of states run by kings and princes: 'The fabric of imperialism and feudalism,' noted W.W. Ehrmann in 1947, 'was threaded with autocratic rulers, which left political authority concentrated in the hands of a very small number of individuals across the subcontinent.'<sup>238</sup> Although the British Empire had taken direct control of vast swathes of India, significant areas were left untouched and hence remained comparatively underdeveloped. The lack of development in education and the free market, in particular, severely affected the establishment of medical technology communities in states such as Rajasthan and Sikkim.<sup>239</sup>

Several states within the boundaries of Imperial India were governed by kings and princes who operated more or less independently.<sup>240</sup> Rajasthan, the largest such state in India, is an especially revealing example: it was a princely state under the Raj prior to independence,

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<sup>237</sup> S.K. Majumdar, *India's Late, Late Industrial Revolution: Democratizing Entrepreneurship* (Cambridge, 2012), p. 114.

<sup>238</sup> Ehrmann, 'Post-War Government and Politics of India', p. 662.

<sup>239</sup> D.P. Henige, *The Princely States of India: A Chronological Checklist of Their Rulers* (New York, 1997), p. 182.

<sup>240</sup> T. Das, 'The Status of Hyderabad During and After British Rule in India', *The American Journal of International Law*, 43 (1) (January 1949), p. 70.

which meant that the imperial government exerted little influence over much of its medical and educational infrastructure.<sup>241</sup> One consequence of this policy was that Rajasthan's literacy rate at independence stood at only 9 per cent, compared to a national rate of 12 per cent, and there was not a single university in the entire state.<sup>242</sup> Medical clinics were few and far between, with only eight in the state as a whole. Clean or piped water was available in only five villages and there was no structural irrigation system in the entire state for agricultural use.<sup>243</sup> Although this situation improved once Rajasthan became a state within a federalized and democratically ruled nation, conditions in Rajasthan underscored the extent to which the princely regions of India lacked many of the resources and infrastructure that British-ruled India possessed, putting citizens of these states even further behind an already largely unindustrialized country.

The country as a whole was also still feeling the impact of one of the major tragedies of the twentieth century: the great Indian famine of 1943. Already caught between two armies – one consisting primarily of British forces, the other Japanese – the summer of 1943 brought severe drought to most of the subcontinent. When measured by mortality in a single year, the 1943 famine was the third worst in the world over the course of the twentieth century, behind famines in China in 1927 and 1943.<sup>244</sup> The famine struck the north-eastern part of subcontinent most severely, particularly in the Calcutta region and the state of Bengal.<sup>245</sup> The famine killed an estimated 3 to 5 million people and left tens of millions more without proper nutrition. One American journalist wrote in visceral terms of the famine's impact:

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<sup>241</sup> Government of Rajasthan, Official Web Portal. Accessed 4 September 2014 at <http://rajasthan.gov.in/StateProfile/Pages/StateProfile.aspx>.

<sup>242</sup> J.P. Nayaka and S. Nurullah, *A Students' History of Education in India (1800–1973)* (Delhi, 1974), p. 138.

<sup>243</sup> S.D. Iyengar, K. Iyengar, and V. Gupta, 'Maternal Health: A Case Study of Rajasthan', *Journal of Health, Population and Nutrition*, 27 (2) (2009), p. 274.

<sup>244</sup> S. Devereux and K. Berge, *Famine in the Twentieth Century* (Brighton, 2000), p. 6.

<sup>245</sup> R. Stevenson, *Bengal Tiger and British Lion: An Account of the Bengal Famine of 1943* (Lincoln, 2005), p. 3.

I saw that the floor was covered with huddled bodies some wrapped in strips of dirty white cotton most of them naked. They were crowded hip to hip and as I picked my way toward the street I couldn't help stepping on many of them only a few groaned or whimpered even the babies – and there were hundreds of them – lay limp and quiet apparently too weak to cry. And it was plain that some of those people on the station floor were dead, and had been dead for a long time.<sup>246</sup>

The famine of 1943 would permanently change the psyche of Indian policy making, placing agriculture and the nutritional supply chain ahead of investments in the healthcare technology infrastructure at the top of the country's developmental agenda for the coming decades. The first, second, and third five-year plans made agricultural development the cornerstone of India's centralized planning process, ensuring that the nation would never again suffer a famine of the size and scope that it experienced in 1943. Thus, India was able to adapt and learn from the tragedy.



Figure 2: Two lines of travellers are waiting at an airport. One line is marked 'UNO' and contains people representing world famine and world war. The other line is marked 'Passengers for India' and contains Victor

Alexander, Stafford Cripps and Frederick Pethick-Lawrence.<sup>247</sup>

<sup>246</sup> J. Fischer, 'India's Insoluble Hunger', *John Harper's Magazine*, 1 April 1945, pp. 438–9.

<sup>247</sup> Accessed at [www.friendskorner.com/forum/f137/debate-illingworth-cartoons-india-daily-mail-uk-1942-1946-a-267120/](http://www.friendskorner.com/forum/f137/debate-illingworth-cartoons-india-daily-mail-uk-1942-1946-a-267120/).

The need for centralized expansion of India's agricultural capacity was underlined by the rising inflation rates that affected many goods and services, especially food, in the years immediately following World War II.<sup>248</sup> Much of the price increase was due to shortages in basic oils and cooking materials, which caused considerable social and economic instability across India. The resulting disturbances and riots only exacerbated the shortages in food goods by interfering with the distribution and supply chain system.<sup>249</sup> The inflationary tendencies of the Indian economy, so striking in the years immediately before independence, continued to be a major factor affecting the country's business and medical technology development throughout the twentieth century. The consequences of inflation became an on-going factor in both the growth of India's medical technology, particularly as export markets grew in the latter part of the century.

### **III. The State of Healthcare in India on August 15, 1947**

In 1943, the government created the 'Health Survey and Development Committee' also known as the Bhore Committee after its chairman, Joseph Bhore-- to evaluate India's health services.<sup>250</sup> The committee was charged with making 'a broad survey of the present position in regard to health conditions and health organization in British India' and 'recommendations for future developments.'<sup>251</sup> The committee submitted a four volume final report in 1946 identifying many areas of healthcare that needed improvement. Therefore, public health and its accompanying medical technology were amongst a number of priorities prior to independence in August 1947.

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<sup>248</sup> Moore, 'India's Market for Industrial Goods,' p. 11.

<sup>249</sup> Soaring Prices of Foodstuffs: Rise In Cost of Living,' *Times of India*, 11 February 1947, p. 5.

<sup>250</sup> V. Bajpai and A. Saraya, 'For a Realistic Assessment A Social, Political and Public Health Analysis of Bhore Committee', *Social Change*, 41 (2) (2011), p. 216.

<sup>251</sup> *ibid.*

The new leadership's recognition of India's healthcare needs was the catalyst to improving the nation's medical technology and public health system.

The *Report of the Health Survey and Development Committee* confirmed that India's healthcare system needed significant improvement. In 1941, the death rate in British India was '21.8 per 1,000 population' and '158 per 1,000 live births.'<sup>252</sup> The death rate was almost double that of the United States, Germany, and England. The infantile mortality rate was close to three times the rates for those countries.<sup>253</sup> A major in the Indian Medical Service, P.M. Kaul, also documented the overwhelmingly high death rate in the provinces of British India from 1937 to 1944 in a report for the Public Health Commissioner. India's inability to deal with its high incidence of diseases such as malaria, cholera, smallpox, and the plague, was a major factor in its high death rates.<sup>254</sup> For example, India was the 'largest reservoir of smallpox infection', despite the vaccine being available there for seventy to eighty years.<sup>255</sup>

India's healthcare problems were aggravated by malnutrition. The diet of the Indian population was 'defective both in quality and quantity', with '80 to 90 per cent of consumed food consisting of cereals, like, rice and wheat.'<sup>256</sup> India's production of foods such as vegetables, fruits, milk, meat, fish, and eggs was insufficient for the populace.<sup>257</sup> Of the many statistics provided by the report, one of the most shocking was that Indians on average consumed about 1,750 calories per day, a figure that compared to about 2,800 calories per day for the average Briton during the same time period.<sup>258</sup> The daily requirements for an ordinary adult were

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<sup>252</sup> *Report of the Health Survey and Development Committee*, Vol. I (New Delhi, 1946), p. 8. Accessed 16 July 2014 at [www.nhp.gov.in/bhore-committee](http://www.nhp.gov.in/bhore-committee).

<sup>253</sup> *ibid.*

<sup>254</sup> *ibid.* pp. 10–11.

<sup>255</sup> *ibid.*

<sup>256</sup> *ibid.*, pp. 12, 54.

<sup>257</sup> *ibid.*, p. 12.

<sup>258</sup> J.M. Harries and D.F. Hollingsworth, 'Food Supply, Body Weight, and Activity in Great Britain, 1943–9,' *British Medical Journal* 1.4801 (1953), p. 77.

an estimated 2,400 calories; 2,500 to 2,600 calories for an adult engaged in moderate work; and 2,800 to 3,000 calories for an adult in heavy manual labour.<sup>259</sup> A number of government officials believed that if malnutrition could be addressed, many of India's healthcare problems would disappear.<sup>260</sup> Nutrition became a part of the new platform for human rights, and in doing so, significantly helped to reduce the mortality rate in India over the twentieth century.<sup>261</sup> Moreover, the elimination of malnutrition would have desirable political effects, helping to stabilize regions of the country plagued by poverty and unrest.

The service side of the healthcare system was also deficient. The report revealed the startling fact that the nurse to population ratio, which stood at 1 to 300 in the United Kingdom, was at 1 to 43,000 in India.<sup>262</sup> The doctor to population ratio, meanwhile, was 1 to 6,300 in pre-independence India, compared to 1 to 1,000 in the UK. Furthermore, the majority of the 47,400 doctors available in India were in private practice – 13,000 were on staff for government medical institutions – which meant that they predominantly worked in urban areas. Therefore, the rural areas where 90 per cent of the population lived lacked adequate skilled medical aid. There were also insufficient hospital beds, a mere 73,000, or roughly 0.24 beds per 1,000 of the population. By comparison, the United States had 10.48 beds per 1,000 of the population and England had 7.14 beds. And even if you could get a bed, the quality of the medical treatment was severely lacking: one dispensary, for example, saw about 75 patients in an hour, an average of 48 seconds per patient.<sup>263</sup>

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<sup>259</sup> *Report of the Health Survey and Development Committee*, Vol. II, pp. 69–70.

<sup>260</sup> D. Porter. (ed.) *The History of Public Health and the Modern State*, Vol. 26 (Amsterdam, 1994), p. 335.

<sup>261</sup> M.R. Anderson and S. Guha, *Changing Concepts of Rights and Justice in South Asia* (Oxford, 2000), p. 200.

<sup>262</sup> *Report of the Health Survey and Development Committee*, Vol. I, p. 13.

<sup>263</sup> *ibid.*, pp. 13-15.

India's healthcare conditions were only made worse during World War II. In 1942, there was a shortage in rice production in Bengal which led to increased prices for rice.<sup>264</sup> By 1943, Bengal was suffering from a severe famine, since the cost of rice was too high for the average person.<sup>265</sup> The Great Bengal Famine caused the death of approximately two million people.<sup>266</sup> As Secretary of State V.P. Menon stated in a letter to the Secretary General of the United Nations in April 1947: 'I need not remind you of the terrible results of the Bengal famine nor the widespread conditions of scarcity which have persisted in India ever since and which still persist to [sic] day.'<sup>267</sup> The letter went on to talk about the efforts necessary to help India regain its food supply, including improving imports for seeds, as well as ways in which the UN could assist in those efforts.<sup>268</sup> Even in April 1947, the Indian government was still reeling from the effects of the Bengal famine.

The view that India's healthcare system was inadequate was confirmed by public officials. In a 1947 newspaper editorial, the chief minister of Bombay, B.G. Kher, stated that 'Public health and hygiene must be considerably improved.'<sup>269</sup> He suggested that significant improvements to India's public health and medical systems would reduce the gap between rich and poor, as well as mitigating the exploitation of the latter. His policy defining speech went on to say that whilst public health was on a long list of the key policies of the new government, it was at the very top of his development plan. Kher also made it clear that he felt that public health improvements were entirely consistent with the Congress party platform: 'It will only be [when

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<sup>264</sup> S.Y. Padmanabhan, 'The Great Bengal Famine', *Annual Review of Phytopathology*, 11 (1973), p. 11.

<sup>265</sup> *ibid.*

<sup>266</sup> *ibid.*

<sup>267</sup> V. Menon, Office of External Affairs, Government of India, 1947, pp. 1–2, NAI.

<sup>268</sup> *ibid.*

<sup>269</sup> B.G. Kher, 'Our New India', *Times of India*, 3 August 1947, p. 8.

there is healthcare equity for all] that we shall have realized the Congress ideal that Free India may develop into a cooperative commonwealth.<sup>270</sup>

#### **IV. The State of Medical Education in India on August 15, 1947**

India's scientific educational infrastructure at the point of independence lagged behind other countries, in large part due to a history of importing expertise and advice from the United Kingdom and elsewhere.<sup>271</sup> In this section, the educational infrastructure in pre-independence India will be explored, including colleges and universities for early training, as well as scientific organizations and institutions for development in the later years of a scientist's career.<sup>272</sup>

Pre-independence India's medical education needed improvement. The Roorkee Engineering College, founded in 1847, was one of the oldest engineering schools in the world, but a century later, the school had only twenty teachers.<sup>273</sup> By comparison, the Tokyo Engineering College and the Massachusetts Institute of Technology, established in 1873 and 1865 respectively, had academic staffs of 70 and 306.<sup>274</sup> The *Report of the Health Survey and Development Committee* noted that there were about 19 medical colleges located in India, mainly in the provinces of Madras, Bombay, Central Provinces and Berar, Bengal, the United Provinces, the Punjab, Bihar, and Orissa.<sup>275</sup> However, only 1,200 students admitted to these colleges every year for medical training. The laboratory facilities and equipment in these medical colleges

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<sup>270</sup> *ibid.*

<sup>271</sup> R.M. MacLeod, 'Scientific Advice for British India: Imperial Perceptions and Administrative Goals, 1898–1923', *Modern Asian Studies* 9 (3) (1975), p. 346.

<sup>272</sup> N. Bella, *Impact of Demographic Trends on the Achievement of the Millennium Development Goal of Universal Primary Education*, p. vii-4. Accessed at [www.un.org/esa/population/publications/PopAspectsMDG/06\\_UNESCO.pdf](http://www.un.org/esa/population/publications/PopAspectsMDG/06_UNESCO.pdf).

<sup>273</sup> C.N.R. Rao, 'Science and Technology Policies: The case of India', *Technology in Society* 30 (2008), pp. 244–45.

<sup>274</sup> *ibid.*

<sup>275</sup> *Report of the Health Survey and Development Committee*, Vol. I, p. 158.

needed improvement, especially after World War II.<sup>276</sup> There were no special facilities ‘available in the universities for the training of teachers in the different subjects of the medical curriculum.’<sup>277</sup> The *Report of the Health Survey and Development Committee* also noted that pharmaceutical education was insufficient.<sup>278</sup>

However, India was taking steps to develop medical education. For example, in 1932 the All Indian Institute of Hygiene and Public Health was established to make post-graduate education on the management of public hygiene available to public health workers.<sup>279</sup> The Institute issued diplomas in Public Health and Hygiene, as well as Maternal and Child Welfare, Masters in Public Health and Engineering, and Certificates in Industrial Hygiene, Nutrition, Lab Technology, and Biometric Techniques. There were also a handful of extant scientific organizations in place prior to independence, including the Council of Scientific and Industrial Research (CSIR), which was established in 1942, and the Tata Institute of Fundamental Research in Mumbai, founded in 1945 through a donation from the Tata trust.<sup>280</sup> The Tata family provided many such donations to aid the new republic’s growth in science and technology during and immediately following India’s transition to independence.<sup>281</sup>

Furthermore, the Health Survey and Development Committee observed that India’s medical education infrastructure was scattered. Therefore, the Committee recommended the development of the All-India Medical Institute to centralize and coordinate medical education.<sup>282</sup> The Institute would bring together all educational facilities for medicine/health, promote

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<sup>276</sup> *ibid.*, p. 162.

<sup>277</sup> *ibid.*, p. 166.

<sup>278</sup> *ibid.*, p. 173.

<sup>279</sup> Report on the Public Health Programs of India, Government of India Health Ministry (1932), NAI.

<sup>280</sup> Tata Institute of Fundamental Research. Accessed at [www.tifr.res.in/index.php/about-us/general-info/history.html](http://www.tifr.res.in/index.php/about-us/general-info/history.html).

<sup>281</sup> P. Chakrabarti, *Western Science in Modern India: Metropolitan Methods, Colonial Practices* (New York: 2004), p. 287.

<sup>282</sup> Report of the Health Survey and Development Committee, Vol. II, p. 431.

research, coordinate training and research, provide post-graduate training, and inspire students. It initially focused mainly on training doctors and nurses, but later training for other health workers was provided.<sup>283</sup> The Committee stated that the Institute if developed properly, ‘will profoundly influence medical education in India in the same manner in which the establishment of the Johns Hopkins Medical School at Baltimore in the United States more than 50 years ago had a powerful stimulating effect on the development of medical education in that country.’<sup>284</sup> It is evident that the leaders of India quickly recognized that scientific and medical institutions were needed to build a country with a strong medical and technological base.<sup>285</sup> In 1952, six years after the *Report of the Health Survey and Development Committee*, the first foundation stone of the All India Institute of Medical Sciences (AIIMS) was laid; it was finally completed in 1956, quickly becoming the centre of ‘nurturing excellence’ in healthcare.<sup>286</sup> AIIMS will be discussed in more detail in Chapter 4.

In addition to the AIIMS, India also developed central organizations for research. In a February 1945 article, Professor A.V. Hill, M.P. – joint recipient of the 1922 Nobel Prize in Physiology for his work on the production of heat and the mechanical work in muscles<sup>287</sup> – discussed the need for India to establish several scientific organizations similar to that of the Royal Society of London.<sup>288</sup> Hill highlighted the need for a central organization for scientific research to be placed under the purview of a government minister independent of any specific administrative departmental obligations. These research boards included the fields of natural

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<sup>283</sup> *ibid.*, p. 432.

<sup>284</sup> *ibid.*, p. 433.

<sup>285</sup> P.R. Rao, ‘India: Science and Technology from Ancient Time to Today’, *Technology in Society*, 19 (3/4) (1997), pp. 416–17.

<sup>286</sup> All India Institute of Medical Sciences. Accessed 17 July 2014 at [www.aiims.edu/aiims/aboutaiims/aboutaiimsintro.htm](http://www.aiims.edu/aiims/aboutaiims/aboutaiimsintro.htm).

<sup>287</sup> A.V. Hill, *Biographical Memoirs of Fellows of the Royal Society*, 1 (71) (1945), p. 24.

<sup>288</sup> ‘India’s Scientific Needs Prof. Hill’s Recommendations’, *The Scotsman*, 1 February 1945, p. 8.

resources, medicine, agriculture, industry, engineering, and war.<sup>289</sup> His recommendations were taken seriously: within five years of Indian self-rule, boards had been established in each of these areas.<sup>290</sup>

Despite the lack of institutional support for widespread education in engineering and the sciences, India nevertheless produced several eminent scientists in the early-twentieth century. These include J.C. Bose, who produced and measured some of the first electromagnetic waves; S.N. Bose, who formulated part of the Bose-Einstein Statistical Model;<sup>291</sup> and C.V. Raman, who was awarded the Nobel Prize in Physics for the Raman Effect of scattering light in 1930.<sup>292</sup> A report from the League of Nations in the National Archives of India details the work of the scientists and their contributions, from improved agricultural techniques to collaboration on international clinical trials.<sup>293</sup>

## **V. The Importance of India's Natural Resources**

Despite the myriad issues plaguing the country at the time – including food shortages, threats against the government from religious extremist groups, and an economy ravaged by World War II – India was among the eight leading industrial countries in the world in August 1947.<sup>294</sup> India had the largest railway system in Asia, and boasted communication and financial systems that were amongst the top in the continent.<sup>295</sup> One of India's greatest advantages, however, was its store of natural resources which provided the potential to develop and export large quantities of

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<sup>289</sup> *ibid.*

<sup>290</sup> Rao, 'Science and Technology Policies', pp. 244–5.

<sup>291</sup> R. Singh, 'India's Physics and Chemistry Nobel Prize Nominators and Nominees in Colonial and International Context', *Notes and Records of the Royal Society* 61 (3) (2007), p. 334.

<sup>292</sup> J. Lourdasamy, *Science and National Consciousness in Bengal: 1870-1930*, Vol. 8 (New Delhi, 2004), p. 130; Chakrabarti, *Western Science in Modern India*, p. 192.

<sup>293</sup> League of Nations, 'Activities of the Health Organization of the League of Nations During the War' Geneva, Switzerland, 1945, NAI.

<sup>294</sup> Ehrmann, 'Post-War Government and Politics of India', p. 659.

<sup>295</sup> *ibid.* p. 660.

technology for use in medicine.<sup>296</sup> Furthermore, many countries from around the world, particularly those within the commonwealth, found the natural resources in India very attractive as a place to either harvest commodities or actually manufacture products and services. This section will assess the natural resources indigenous to the subcontinent, which had long been recognized as a tremendous asset by nations around the world and entrepreneurs within India. This section will also consider criticisms that the Indian government did not make better use of the natural resources at its disposal.

Jute, a long soft vegetable fibre that can be spun into twine, rope, and matting for medical supplies, was one of the natural resources that helped grow India's medical technology.<sup>297</sup> Grown in rice fields with different grades of quality, jute was plentiful in pre-independence India.<sup>298</sup> The Borneo Company, a British trading company, built the 'first large-scale jute spinning and weaving mill' in Calcutta in 1859.<sup>299</sup> However, the jute industry did not grow as fast as other industries: by 1911, for example there were 261 cotton textile mills in India and only 54 jute mills.<sup>300</sup> Indian jute manufacturers were also heavily taxed making it difficult to compete with the artificial fibre manufacturers.<sup>301</sup> Therefore, the importance of jute was not being capitalized on in pre-independence India.

India's tally of natural resources included considerably more than just jute. A medical-botanical inventory carried out by Dr. U.K. Sharma, a botanist from Dhemaji College, found that the state of Assam had over thirty plants that could be used for medical-religious purposes.<sup>302</sup> His

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<sup>296</sup> N. Nilekani, *Imagining India: The Idea of a Renewed Nation* (New York, 2009), p. 371.

<sup>297</sup> 'Natural Resources of India: Pleas for Exploitation A Special Correspondent', *Times of India*, 26 February 1938, p. 16.

<sup>298</sup> D. Rothermund, *An Economic History of India* (New York, 1988), pp. 56–7.

<sup>299</sup> *ibid.*, p. 57.

<sup>300</sup> *ibid.*, p. 58.

<sup>301</sup> 'Natural Resources of India', 26 February 1938, p. 16.

<sup>302</sup> U.K. Sharma, 'Medico-Religious Plants Used by the Hajong Community of Assam, India', *Journal of Ethnopharmacology* 143 (3) (2012), p. 789.

phytochemical investigation and botanical inventory chronicled the rich diversity of the plant life in Assam.<sup>303</sup> India also had an abundance of chromite, a rare mineral essential to manufacturing stainless steel. As an article dated August 8, 1945 confirmed, ‘India ranks with Soviet Russia as one of the very few countries with vast resources of chromite, a mineral of considerable value.’<sup>304</sup> Such resources gave India a clear advantage over its competitors; indeed, its raw materials would eventually propel the nation to become one of the world’s medical technology leaders. Such rich biodiversity allowed pharmaceutical and other medical technologists to come into India, and for Indians in turn to use their own internal resources for its medical technology.

The *Report of the Health Survey and Development Committee*, published in 1946, discussed the potential of India’s large supply of ‘botanicals’ or natural resources.<sup>305</sup> It listed ‘a few important drugs manufactured from raw material found in India’: morphine, codeine, strychnine, caffeine, santonine, quinine, pyrethrum, and ipecacuanha. In addition, the report stated that efforts should be made to recover the valuable chemicals, i.e. carbolic-acid, benzene, and toluene, found in coal tar that are used for synthetic drugs. India also had the necessary raw material to manufacture glass articles of a simple nature. India not only possessed the requisite minerals and natural botanical ingredients for a strong basis in the pharmaceutical industry, its nascent life science industry also had the potential to become significant.<sup>306</sup>

In 1950, C.N. Vakil provided an analysis of India’s natural resources in *Economic Consequences of Divided India*. He stated that although synthetic drugs are produced from imported materials, India had many of the raw materials needed for the drugs industry.<sup>307</sup> For example, India had large amounts of great purity deposits of magnesite, which can be used in

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<sup>303</sup> *ibid.*

<sup>304</sup> ‘India's Chromite resources’, *Times of India*, 8 August 1945, p. 8.

<sup>305</sup> *Report of the Health Survey and Development Committee*, Vol. I, pp. 50–3.

<sup>306</sup> *ibid.*, pp. 51–3.

<sup>307</sup> C.N. Vakil, *Economic Consequences of Divided India* (Bombay, 1950), pp. 319–20.

refrigeration plants and high grade quartz sands used for making clear glass, laboratory ware, and optical glass.<sup>308</sup> Ores of arsenious oxide, or white arsenic, employed in medicine, were discovered in Darjeeling.<sup>309</sup> India also possessed saltpetre, a valuable fertiliser, and phosphates which are essential for plant life and can be used by the metallurgical industries.<sup>310</sup>

Like Bhole in the *Report of the Health Survey and Development*, Vakil criticized India's mineral industry, stating that its development was being stifled due to 'lack of policy and organised plans for prospecting, mining and utilisation of minerals', 'lack of effective State control, assistance, and encouragement', 'lack of trained men and technical skill', and 'inroads by foreign firms who have taken up concessions for most of the important Indian minerals.'<sup>311</sup> He stated that although other countries like the U.S. and U.S.S.R., possessed more mineral resources than India, those countries had already consumed large portions of their mineral resources, whereas India had yet to use its available mineral wealth.<sup>312</sup>

Criticism of the imperial government's under-utilization of the natural resources started years before the *Report of the Health Survey and Development Committee*. Foremost amongst the critics was India's business leadership. On February 25, 1938, at the Annual Meeting of the Chamber of Commerce for India, M.L. Shah, the Chamber's retiring president declared: 'As to India's economic condition, there had been a singular lack of a system and any well thought out plans for the exploitation of the country's vast natural resources.'<sup>313</sup> Shah concluded by criticizing the government for not monitoring and adapting to developments in international markets.<sup>314</sup> The authors of 1944's Bombay Plan, which included many of India's leading

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<sup>308</sup> *ibid.*, p. 213.

<sup>309</sup> *ibid.*,

<sup>310</sup> *ibid.*, p. 214.

<sup>311</sup> *ibid.*, pp. 216–7.

<sup>312</sup> *ibid.*, pp. 218–9.

<sup>313</sup> 'Natural Resources of India: Pleas for Exploitation A Special Correspondent', 26 February 1938, p. 16.

<sup>314</sup> *ibid.*

industrialists, also advocated the full use of India's natural resources. It set out a plan of economic development that split the growth of India's Gross Domestic Product into Agriculture and Industry.<sup>315</sup> 'Enterprises owned wholly or partially by the state, public utilities, basic industries, monopolies, industries using or producing scarce natural resources and industries receiving state aid should normally be subject to control,' they declared.<sup>316</sup> In other words, the architects of the Bombay Plan, whilst advocating a strong position for regulation and state control, wanted to see the natural resources of India tapped to their fullest extent.

Another advocate for exploiting the natural botanical resources that would stimulate India's pharmaceutical and medical technology was Professor J.N. Mukherji, the General Secretary of the Indian Science Congress.<sup>317</sup> He pointed toward the botanical studies undertaken in places like Assam, which had led to the establishment of the Royal Botanical Garden Survey of India, and argued that a proper inventory of the country's plants was the only way to take advantage of India's natural resources. Mukherji continued by explicitly connecting the exploitation of natural resources to the potential success of educational and research institutions that required these natural resources.<sup>318</sup>

Criticism that the Imperial government was not fully exploiting India's natural resources also came from abroad. In a July 31, 1943 editorial in *The Pittsburgh Courier*, Kumar Goshal, an Indian expatriate-turned global rights columnist, suggested that Britain and America were not doing enough to utilize India's vast natural resources.<sup>319</sup> He argued that if more were done to help India industrialize, it would both contribute to the Allied war effort and allow the country to

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<sup>315</sup> "'Need for State Control of All Industries Bombay Plan Authors' Memorandum', *Times of India*, 17 January 1945, p. 5.

<sup>316</sup> *ibid.*

<sup>317</sup> J.N. Mukherji, 'Modern Science In India: Significance of Indo-British Congress', *Times of India*, 16 December 1937, p. 4.

<sup>318</sup> *ibid.*

<sup>319</sup> K. Goshal, 'As An Indian Sees It', *Pittsburgh Courier*, 31 July 1943, p. 6.

compete economically around the globe. ‘What about vast resources of India?’ he asked. ‘What did we have and what did we do with it? We had a vast reservoir of man power and natural resources in India, for instance, but did nothing with them.’ Goshal continued by asserting that it was as a result of India’s under-development that the Axis powers had increased their influence across much of eastern India.<sup>320</sup>

As the majority of contemporary commentary on the economic situation in pre-independence India made clear, the natural resources of the subcontinent were generally seen to approach levels of self-reliance. Indeed, an author for the journal *Pacific Affairs* reached precisely this conclusion: ‘A large country, rich in natural resources like the United States and Russia, India can have a more or less self-sufficient economy.’<sup>321</sup> The perception that India’s natural resources represented a substantial competitive advantage in the global market was common amongst governmental and political leaders. Their policy responses often exhibited a combination of a lack of planning and coordination and heavy domestic and export taxation, both of which significantly stunted the use of these resources and the ability for the economy to become self-sufficient. This created an awkward environment for the medical technology: India was in a position to achieve incredible growth, but faced government barriers to both domestic and foreign markets.

## **VI. The State of Medical Technology in India on 15 August 1947**

The modern pharmaceutical industry was introduced to India by the British. India soon became a profitable market for many Western companies, with nine Western firms ‘established before

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<sup>320</sup> *ibid.*

<sup>321</sup> K. Shridharani, ‘India in a Changing Asia’, *Pacific Affairs* 14 (1) (1941), pp. 12–13.

1915, and another 44 by 1947.<sup>322</sup> The number of workers employed in chemicals and drugs factories increased from 1946–48.<sup>323</sup> For example, Sandoz, a Swiss pharmaceutical company, began operations in India as early as the 1920s, established a firm presence in 1938.<sup>324</sup> There were also Indian companies that ‘specialised in herbal and alternative systems of medicine’, like Bengal Chemicals, Zandu Pharmaceuticals, Arya Vaidyashala and Ayurvedashram Pharmacy.<sup>325</sup> By 1943, India could meet 70 per cent of its medicinal requirements, up from only 13 per cent in 1939.<sup>326</sup> The nation was, however, unable to keep up with the rapid development of the pharmaceutical industry following World War II.

In the 1940s, there was still a lot of medical technology that was imported. A July 12, 1946 article in the *Times of India* outlined India’s purchases from the US in 1945: the total cost of importing goods was \$69,500,000 USD, with the top imported items including manufactured tobacco (\$9,600,000 USD), industrial machinery (\$7,400,000 USD), and coal-tar products (\$6,900,000 USD).<sup>327</sup> The fourth item on the list was medicine and pharmaceuticals; at \$5,600,000 USD, that number was approximately 9 per cent of the total imports on a dollar basis.<sup>328</sup> However, as a result of World War II, there was a marked decrease in the medical technology products imported into India, largely due to the massive damage the war had caused to manufacturing infrastructure around the world. Through strategic policy making India would eventually catch up, becoming very important in pharmaceuticals.

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<sup>322</sup> H. Ahmad, *Technological Development in Drugs & Pharmaceutical Industry in India* (New Delhi, 1988), p. 2.

<sup>323</sup> Vakil, *Economic Consequences of Divided India*, p. 399.

<sup>324</sup> P.K. Ravindranath, *The Indian Pharmaceutical Industry Since Independence* (English Edition, Delhi, 2001), pp. 34, 52.

<sup>325</sup> *ibid.*, p. 52.

<sup>326</sup> *ibid.*, p. 56.

<sup>327</sup> ‘U.S. Exports to India: 1945 Purchases Total \$69,500,000’, *Times of India*, 12 July 1946, p. 4.

<sup>328</sup> *ibid.*

### Key Statistics of the Drugs and Pharmaceutical Industry

Year	Number of Units	Investment (Rs. crores)
1952	1752	24
1962	-	56
1969-70	2257	-
1973	-	225
1977	5201	450
1979	5156	500
1981	6417	-
1983	-	750
1984-85	10000	775

Sources: (1) OPPI Annual Report 1982.  
 (2) Chemical Weekly (Annual Issue) 1986.

*Table 3: Key Statistics of the Drugs and Pharmaceutical Industry*<sup>329</sup>

In pre-independence India, there was no control over the quality of drugs, leading to a problem with counterfeit drugs, which were often dispensed by unqualified persons.<sup>330</sup> There was also a rampant 'grey market' with unregulated marketers selling goods at absorbent prices to the highest bidder. On August 27, 1945, it was reported that, 'Despite the advent of peace, no relaxation of the drug control order can be expected for at least a year because of the prevailing unstable condition of the market.'<sup>331</sup> The article continued to state that although large amounts of

<sup>329</sup> Ahmad. *Technological Development in Drugs*, p. 3.

<sup>330</sup> Maharashtra State Pharmacy Council. Accessed 21 July 2014 at [www.mspeindia.org/General/PharmIndia.aspx](http://www.mspeindia.org/General/PharmIndia.aspx).

<sup>331</sup> 'Control of Drugs to Continue: No Imports Due To Lack Of Shipping', *Times of India*, 27 August 1945, p. 1.

pre-war baby foods and medicines were arriving in Bombay, drug control policies were still necessary due to the lack of supply from the overseas manufacturers. In response, the imperial government placed price controls on the drugs and devices that were imported from overseas for a one-year period. In 1930, the Drugs Enquiry Committee was established to make recommendations on how to regulate the pharmaceutical industry. Two of its proposals were to regulate the ‘import, manufacture, sale and distribution of drugs’ and ‘profession and practice of pharmacy.’<sup>332</sup> The result was the Drugs and Cosmetics Act of 1940, which provided control of imported drugs, as well as drugs manufactured and sold in India.<sup>333</sup> The Act also established a Drugs Technical Advisory Board to advise the central and state governments and the Central Drugs Laboratory to analyse samples of imported drugs.<sup>334</sup>

Another bright spot in the pre-independence Indian economy was chemical supplies. The Chemical, Industrial and Pharmaceutical Laboratories (CIPLA) – today one of the largest pharmaceutical-manufacturing firms in the world – was the only one of India’s current top five medical technology firms founded before Independence.<sup>335</sup> In 1935, Dr. K.A. Hamied, a chemist and Indian nationalist, founded CIPLA ‘when there wasn’t a single pharmaceutical company in the country.’<sup>336</sup> Hamied’s goal was to make India self-sufficient, but he developed a huge force in pharmaceuticals at the same time.<sup>337</sup> In 1939, Mahatma Gandhi visited CIPLA, motivating them to manufacture necessary medicines for India and strive for self-sufficiency.<sup>338</sup> CIPLA’s first great opportunity came during World War II: since Great Britain was too busy with the war

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<sup>332</sup> *ibid.*

<sup>333</sup> *Report of the Health Survey and Development Committee*, Vol. I, p. 50.

<sup>334</sup> *ibid.*, pp. 50–1.

<sup>335</sup> W. Greene, ‘The Emergence of India’s Pharmaceutical Industry and Implications for the U.S. Generic Drug Market’, US International Trade Commission Report, p. 6.

<sup>336</sup> CIPLA, About Us. Accessed 22 July 2014 at [www.cipla.com/Home/About-Us/History.aspx?mid=1289](http://www.cipla.com/Home/About-Us/History.aspx?mid=1289); E. Check, ‘The Treasure of Mumbai’, *Wired Magazine*, December 2006. Accessed 18 September 2014 at <http://archive.wired.com/wired/archive/14.12/indiadrug.html>.

<sup>337</sup> Check, ‘The Treasure of Mumbai’.

<sup>338</sup> CIPLA, About Us.

effort to manufacture medicines, CIPLA was called upon to produce medicines for the war effort.<sup>339</sup> CIPLA manufactured many life-saving drugs during World War II.<sup>340</sup> In present times, it has ‘emerged as one of the world’s most respected pharmaceutical names, not just in India but worldwide’, making drugs for cancer and HIV treatment.<sup>341</sup>



*Figure 3: Gandhi meeting the CEO of CIPLA in 1946*<sup>342</sup>

In 1946, during the tenth annual meeting of the shareholders of CIPLA, it was noted that CIPLA and the chemical and mineral industries were beginning to prosper.<sup>343</sup> The shareholder meeting revealed CIPLA’s growth rate in 1946: ‘In the year under review your company made a net profit of Rs. 3,08,552-11-11, which works only at about 10 per cent of the gross sales.’<sup>344</sup> Hamied provided further remarks on CIPLA’s performance in his discussion of the expansion of pay rates in the years 1943–1945: the number of staff employed by CIPLA in 1943 was 456, a figure which had declined to 443 workers by 1945. The loss of thirteen workers from the middle

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<sup>339</sup> Check, ‘The Treasure of Mumbai’.

<sup>340</sup> CIPLA, About Us.

<sup>341</sup> *ibid.*

<sup>342</sup> CIPLA, About Us. Accessed 22 July 2014 at [www.cipla.com/Home/About-Us/History.aspx?mid=1289](http://www.cipla.com/Home/About-Us/History.aspx?mid=1289).

<sup>343</sup> ‘Steady Progress Maintained By CIPLA: Dr. K.A. Hamied on Future of CIPLA’, *Times of India*, p. 5.

<sup>344</sup> *ibid.*

to the end of the war again suggests the war's positive impact on India's chemical and mineral industry; concomitantly, the decline in the number of workers at the end of the war was the result of the reduction in demand by the British government in the Indian subcontinent.

## **VII. Taxation in British India and Other Policies Hindering Growth**

Taxation in British India during the nineteenth century was based on land and fiscal monopolies.<sup>345</sup> In the beginning of the twentieth century, taxation was changing to a system of taxation on consumption, i.e. taxation of incomes and business.<sup>346</sup> However, the biggest increase in tax revenue for the Indian Government was through import taxes and customs duties, which increased raw material costs and consumer prices.<sup>347</sup> The Indian Fiscal Commission of 1921-2 stated that 'high taxes on income are undoubtedly a handicap to industrial development ... If, therefore, any further increase in taxation becomes necessary, it will have to take the form of indirect taxation ... This means that import duties must continue high.'<sup>348</sup> The Income Tax Act of 1922 was the most comprehensive income tax law and was the beginning of the growth of the Income tax Department.<sup>349</sup>

CIPLA and the chemical and mineral industries had to deal with these increasing import duties, especially since the policy of taxing the goods CIPLA needed for its growth was stunting the company's growth. At the Tenth Annual Meeting of the Shareholders of CIPLA in April 1946, Hamied railed against the British government in his remarks:

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<sup>345</sup> N. Charlesworth, 'The Problem of Government Finance in British India: Taxation, Borrowing and the Allocation of Resources in the Inter-war Period', *Modern Asian Studies*, 19 (03) (1985), p. 526.

<sup>346</sup> *ibid.*

<sup>347</sup> *ibid.*, p. 546.

<sup>348</sup> *ibid.*

<sup>349</sup> J.B. Lala, 'Comparative Analysis of Income Tax Reforms in India Pre and Post 1991', *Proceedings of the Global Conference on Business, Economics and Social Sciences* 2013, p. 114.

The major part of these profits still goes to the government in taxation. Besides this direct taxation, we pay to the government as indirect taxes in custom duties on raw materials, machinery, apparatus, glassware and in the form of abnormal railway freight, large amounts which further reduce our net profits.<sup>350</sup>

Hamied continued to criticize the government's regulations on medical technology, highlighting the example of restrictions on importing critical machinery for manufacturing pharmaceuticals and other chemicals, stating indignantly:

I am at a loss to understand why there should be any license necessary for import of machinery from England when the English manufacturer is ready to supply and we are prepared to buy, and there's no difficulty of exchange as in the case of machinery from U.S.A. and non-sterling areas.<sup>351</sup>

Again, the policies of the imperial government resulted in obstructions to trade that served to stymie the eventual growth of the medical technology industry in pre-independent India. These policies, as we will see in Chapter 3, continued after independence.

Hamied concluded his comments by talking about the nationalization of India's industries and the future prospects of the pharmaceutical and chemical industry. In particular, he made a case for nationalizing India's telegraphs, telephones, railways, quinine, opium, alcohol, and electricity, arguing that they were currently being managed in a highly inefficient way. He went on to underline the need for competition within India in order to produce a world class market, before stating that the scientific and medical communities in the Indian sub-continent had resulted in some of the best chemical and pharmaceutical manufacturers in the world.<sup>352</sup>

Other policies also hindered the advance of medical technology. In October 1945, a meeting took place between Murarji J. Vadya, the President of the Association of Indian

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<sup>350</sup> 'Steady Progress Maintained By CIPLA', p. 5.

<sup>351</sup> *ibid.*

<sup>352</sup> *ibid.*

Industries, and both the Secretary and Joint Secretary of the Department of Industries and Civil Supplies, in which Vadya complained that many of the imperial government's controls over India's domestic industry had been implemented without 'proper consultation' with the Indian Industry Trade Association.<sup>353</sup> Although the government was rationalising price controls due to the grey market, he argued that with the end of World War II the black market was diminishing, which eliminated the need for price controls on many of the goods needed for manufacturing. These controls, he continued, prevented Indian factories from running at full capacity, affecting a wide range of industries, including soap, perfume, and pharmaceutical.<sup>354</sup> Vadya argued that easing price controls would help to build domestic markets for indigenous manufactured goods, as well as markets in neighbouring countries that lacked manufacturing capabilities. Despite these difficulties, India's pre-existing drug and chemical industries were still growing at a faster than normal rate relative to other industries at the time. Employment rates in perennial factories, for example, showed that these industries grew faster than any other in terms of employment in the years between 1946 and 1948.<sup>355</sup>

### **VIII. Conclusion: The Gap between the Former and Current State of Medical Technology**

The economy as a whole in the years immediately prior to independence was suffering from a long period of stagnation, which severely inhibited the ability of medical technology to achieve growth through sales in India's domestic markets. Economic stagnation was mirrored by the state of healthcare, which was drastically underdeveloped, affecting the demand for medical technology and its production. The government's policy responses often exhibited a lack of planning and coordination: heavy domestic and export taxes significantly stunted the growth of

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<sup>353</sup> 'Control Measures and Industries: Plea to Sir A. Hydari', *Times of India*, 26 October 1945, p. 4.

<sup>354</sup> *ibid.*

<sup>355</sup> *ibid.*

India's medical technology. The nation had abundant supplies of minerals and materials with which to grow, but faced bureaucratic barriers to both domestic and foreign markets that prevented it from realizing that growth.

India was still some way off from establishing a viable medical technology complex. As the second and third sections of this chapter showed, the majority of the Indians were desperately poor and healthcare was inadequate. Furthermore, stakeholders like the current governments and religious organizations were preoccupied with Indian independence and the attendant outbreaks of violence. Although foreign corporations were profiting from India, none of this money was being invested in developing India's medical technology. Despite all of the poverty, hunger, and unsupportive imperial tax policies with which India was faced, however, there were still traces of a medical technology foundation. India possessed educational and scientific organizations, an international network of scientists, an industrial base possessed of an abundance of natural resources, and a population of 300 million. Chapter 3 will discuss India immediately post-independence and the developments made to allow India to further develop medical technology during that tumultuous time.

### Chapter 3: India's Emergence as an Independent State – 1947 to 1951

‘Health is fundamental to national progress in any sphere. In terms of resources for economic development, nothing can be considered of higher importance than the health of the people which is a measure of their energy and capacity as well as of the potential of man-hours for productive work in relation to the total number of persons maintained by the nation. For the efficiency of industry- and of agriculture, the health of the worker is an essential consideration.’<sup>356</sup>

– *India's Planning Commission, First Five-Year Plan, Part 3, Chapter 32 – Health*

India achieved independence on August 15, 1947 and Jawaharlal Nehru became its first Prime Minister.<sup>357</sup> On November 26, 1949 the Constitution of India was adopted and became operative on January 26, 1950.<sup>358</sup> The Constitution provided for two levels of Government: one at the Central level and another at State level.<sup>359</sup> In a bid to address the issue of health and many other aspects of social and political life in India, Article A 246 of the Constitution stated that, ‘The State shall regard the raising of the level of nutrition and the standard of living of its people and the environment of public health as among its primary duties.’<sup>360</sup> Given the funding that the government eventually provided for nutritional programmes, the constitution indicates that from an early point in its independence, India's government was already responding to the population's demands for improvements in the condition of public health.<sup>361</sup>

The central government's efforts to assert its power across such a vast territory met with numerous logistical and political difficulties, especially in the field of healthcare. This chapter

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<sup>356</sup> India's Planning Commission, First Five-Year Plan, Part 3, Chapter 32 – Health. Accessed 18 July 2014 at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

<sup>357</sup> G. Sabharwal, *India Since 1947: The Independent Years* (New Delhi, 2007), p. 8.

<sup>358</sup> Lala, ‘Comparative Analysis of Income Tax Reforms in India Pre and Post 1991’, p. 114. Accessed 22 July 2014 at [www.worldresearchconference.com/gbsr2013/eproceeding/YG%20DAH%20PDFkan/031.pdf](http://www.worldresearchconference.com/gbsr2013/eproceeding/YG%20DAH%20PDFkan/031.pdf).

<sup>359</sup> *ibid.*

<sup>360</sup> J.E. Park, *Textbook of Preventive and Social Medicine: A Treatise on Community Health*, 3rd edn. (Prem Nagar, 1972), p. 641.

<sup>361</sup> India's Planning Commission, Second Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

will consider why the newly created Indian Health Service responded to the challenges it faced by cutting off drug and device aid supplied by foreign medical missions, one of the country's primary sources of life-saving medical technologies (usually referred to as drugs and appliances rather than pharmaceuticals and devices).<sup>362</sup> This chapter also contends that the policy of starving medical missions of aid was enacted in order to placate the increasingly popular and powerful Hindu religious elite by targeting foreign, predominantly Christian, missions.<sup>363</sup> The friction between Nehru's emerging secular government and religious groups was also evident when the Hindu nationalist organization Rashtriya Swayamsevak Sangh (RSS), was banned due to threat it was deemed to pose the government after the assassination of Gandhi in 1948.<sup>364</sup>

### **I. Overwhelming Medical Challenges in the First Days of the Nation**

During and immediately following independence, the new nation experienced a series of horrific events that placed an enormous strain on the country's medical and health services. Not the least was the Partition between India and Pakistan, one of the largest migrations in history.<sup>365</sup> The migration that followed Partition resulted in the temporary encampment of an estimated 10 million people, with Hindus in mass flight to India and Muslims crossing over to Pakistan.<sup>366</sup> Recent estimates by historians have validated this number and have documented other atrocities such as mass killings, rape, and abductions that affected millions of others.<sup>367</sup> Robert Trumbull, a *New York Times* reporter on assignment in New Delhi to cover India's Independence, reported

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<sup>362</sup> 'Import of Drugs and Medicines', *The Times of India*, 17 January 1948, p. 4.

<sup>363</sup> 'No theocratic state envisaged for India', *The Times of India*, 26 January 1948, p. 8; S. Tharoor, *Nehru: The Invention of India* (New York, 2003); B. Zachariah, *Nehru* (London and New York, 2004); P. Spear, 'Nehru', *Modern Asian Studies*, 1 (1) (1967), pp. 15–29.

<sup>364</sup> B. Stein, *A History of India* (Oxford, 2010), p. 33; R. Thandavan, R., 'Hindu Political Expression: RSS in India', *The Indian Journal of Political Science*, 48 (3) (1987), pp. 428–33.

<sup>365</sup> F. Frankel, *India's Political Economy: 1947–2004* (Oxford, 2005), p. 22.

<sup>366</sup> 'The Refugees: A problem that must be solved', *Times of India*, 13 October 13, 1947, p. 6.

<sup>367</sup> P. Virdee, 'Negotiating the Past: Journey through Muslim Women's Experience of Partition and Resettlement in Pakistan', *Cultural and Social History*, 6 (4) (2009), p. 469.

on the horrors in evocative terms: ‘In the last two years I have seen every country in Asia and seen a lot of bloody things, but nothing quite like this.’<sup>368</sup> He went on to say that, ‘I have seen dead by the hundreds and, worst of all, hundreds of living Indians without eyes or hands or feet.’<sup>369</sup>

Migration, temporary internment camps, and terrorist attacks left a wake of infectious disease that took its toll on tens of thousands more. On October 13, 1947, the *Times of India* reported on the state of the refugees with the approach of winter: ‘Apart from ordinary sickness, epidemic diseases like cholera and smallpox have become prevalent both among refugee columns and in camps.’<sup>370</sup> Not only were the Indian health services combating one of the most serious public health issues of the twentieth century, the health services were also attempting to build a new model of post-colonial healthcare delivery, one that would require substantial funding in order to reach a level comparable to the world’s developed countries.

Appeals by public health service leaders for investments in medicine and public health were often ignored as the Central Government sought to build India’s economic base and improve its currency, military defence, educational system, transportation, and public housing.<sup>371</sup> Moreover, officials in the new government had to address inherited problems of an administrative nature, including taxation and the relative responsibilities of local and central authorities. As India emerged from the Second World War and threw off the bonds of more than a century of colonial rule, it was hoped that the world’s newest and largest democracy, which

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<sup>368</sup> R. Trumbull, ‘Bands Organize Massacres in India: Religious Fanaticism and Poverty Behind Use of Terror’, *New York Times*, 14 September 1947, E5.

<sup>369</sup> *ibid.*

<sup>370</sup> ‘The Refugees’, p. 6.

<sup>371</sup> India’s Planning Commission, First Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

was struggling to create a medical system for 300 million people with meagre resources, would harness a wave of idealism and goodwill internationally.

The health system had struggled to recover from the exigencies of wartime, which had transferred resources away from the general population in order to service the front lines. In April 1948, Jivraj Mehta, the Secretary of the Health Ministry and Director General of Health Service and one of Mahatma Gandhi's personal physicians, wrote to G.S. Rau, a member of the Government of India Economy Committee.<sup>372</sup> Mehta informed Rau of the exceptionally poor state of medical care inherited by the new government and indicated the full extent of the shortage of physicians, clinics, medicines, and supplies.<sup>373</sup> Dr. Mehta described how the health services had been co-opted by the British Army to support the recruitment and development of medical doctors and sent clinicians to the front lines. He went on to say that following the war, many health service posts had been 'abolished' and that replacement posts

were created as and when the necessity for them arose, but no scientific plan for the central health organization was worked out because of unstable political conditions, and partly because it was thought undesirable to embark upon any scheme of a permanent nature until the scope and functions of the organization could be clearly visualized.<sup>374</sup>

As Mehta's letter indicates, much of the early planning and development of the Indian Health Service and the nascent medical technology took place against a backdrop of severe political, religious, and social uncertainty. The unrest gripping the nation was one of the major reasons for

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<sup>372</sup> *Barts and the London Chronicle*, 8(1) (2006), p. 4. Mohandas Gandhi was one of Dr. Mehta's patients.

<sup>373</sup> Letter from Jivraj Mehta, Secretary of the Health Ministry and Director General of Health Service to G. S. Rau, Government of India Economy Committee, 31/5/48, NAI (Box 136).

<sup>374</sup> *ibid.*

the lack of progress in the development of India's health services; violence had real consequences not just for these services, but for all infrastructure projects.<sup>375</sup>

Another basic challenge faced by the public health system during the first years of the new republic was the lack of raw materials necessary for the construction of new clinics, hospitals, and factories. It was not only business and the government that had a shortage of building materials, but even the well-funded missions. To take one example, the Cambridge Mission to Delhi, located in the heart of Delhi, had planned to begin construction of a chapel in the month of India's independence.<sup>376</sup> But in a letter dated March 19, 1948, F.J. Western, the Principal of St. Stephen's College, one of the mission's schools, wrote to the General Secretary of the Cambridge Mission to Delhi, Sulston E. Bruford, 'I am sorry to have to report that the College Chapel, the construction of which we had hoped would begin in August 1947, has not yet begun, first because of the disturbances last autumn and now because of the non-availability of cement, bricks, and iron.'<sup>377</sup> He went on to request approval for a plan to begin construction of the chapel in December 1950. Even for organizations that typically had no shortage of funding, the violence of the Partition and subsequent material shortages created insurmountable barriers for medical technology and the corresponding public health and medical system in the first years of independence.

As shortages continued to plague the development of clinics, hospitals, and foreign-financed chapels, the creators of the Indian Health Services, led by Mehta, continued to petition the government for more funding.<sup>378</sup> In a June 1948 letter to the Economy Committee – the body that determined the funding for many of the central government's agencies – Secretary of the

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<sup>375</sup> *ibid.*

<sup>376</sup> Letter from the Right Reverend F.J. Western, 19 March 1948, Oxford, Bodleian Library, USPG Papers, D523/5.

<sup>377</sup> *ibid.*

<sup>378</sup> Letter from Jivraj Mehta, Secretary of the Health Ministry and Director General of Health Service to G. S. Rau, NAI. His letter details the poor state of medicine during the 1947 transfer of government.

Health Ministry Mehta cited a report of 1946 which stated that ‘there has hitherto been no detailed consideration of what the functions of the Central Government are in regard to health.’<sup>379</sup> In essence, Mehta was noting that funding requested in 1946 had yet to materialize; moreover, since that report had been issued, a significant gap in public health and medical services had emerged in the Indian healthcare system. In order to fill this gap, he delineated the role of different levels of government – central, state, and provincial – and explained how other medical systems around the world provided clinical and public healthcare. Over 28 pages, the minister listed the early priorities for the Health Ministry concluding that, given his available funding, it was ‘not possible for his department to perform the functions envisaged above nor for the Central Government to take any substantial part in the solution of health problems of the country.’ He added that ‘this would be true even if there had been no outbreak of war’, anticipating a common response during a period in which many of India’s problems could be traced back to World War II.<sup>380</sup>

Recognizing the vast gap between India’s healthcare system and that of a well-funded nation, Mehta attempted to appeal to the sections of the Indian government that controlled the financing mechanism upon which the Indian Health Service relied:

In the past public health administration (curative and preventative services together) received quite inadequate attention from Governments in India, the proportion which expenditure on such services bears to the total expenditure of these Governments every year being but a small fraction of the corresponding proportion for progressive countries like Great Britain and the U.S.A. On the other hand the need for a departure from the policy of the past and for the formulation and execution of a planned programme of health development is more widely recognized and accepted to-day than ever before.<sup>381</sup>

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<sup>379</sup> *ibid.*

<sup>380</sup> *ibid.*

<sup>381</sup> Letter to the Health Minister, March 1948, NAI (Box 136).

Mehta attempted to persuade central government leaders with data, using the models of two of the world's perceived healthcare leaders – Great Britain and the United States – as exemplars to be emulated as India planned its own system. The memo went on to highlight these two countries as models not only for financing, but also for administration and delivery.<sup>382</sup>

The problems that the newly autonomous Indian Health Service faced were thus perceived to be grave but not insurmountable, and many of the records from this period attest to shared feelings of difficulty and responsibility regarding them. However, persuading the leaders who held the purse strings proved to be difficult. Politicians like Menon, for example, attempted to persuade the Economy Committee by using many of the 'scientific management' concepts espoused by Frederick Taylor in his 1911 book *The Principles of Scientific Management*.<sup>383</sup> Scientific management techniques and the 'quest for efficiency' played an important part in American and to a lesser extent British health care since World War I. However, the reliance on scientific management proved to be a mistake; speech after speech was given by national and local leaders alike, pledging a better healthcare system for all Indians, but the funding that the Indian Health Service so badly needed never materialized.<sup>384</sup> Instead, the central leadership invested in other critical efforts, such as power, agricultural production, and transportation, all of which were sorely needed in a country in which basic human needs such as food and shelter were far from guaranteed.

After independence, P.C. Mahalanobis, P. Pant, and several other Indian officials visited USSR to learn the Soviet approach to planning. India thus developed a planning system similar to the centralized planning first developed by the Soviet Union in the 1920s in which a Planning

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<sup>382</sup> *ibid.*

<sup>383</sup> F. Taylor, *The Principles of Scientific Management* (London, 1911), p. 56.

<sup>384</sup> India's Planning Commission, First Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

Commission dictated how the nation allocated its resources over a five year period. Such plans were seen as a way to ensure that public and private entities aligned their resource allocation according to the goals of the central government. The plans were also designed to ensure that the development of various programmes and infrastructure took place in a systematic and coordinated manner.<sup>385</sup> The five year plan method is still utilised today and forms a core part of India's governmental planning efforts.

India introduced the first of its five-year plans in 1951. Under the first five-year plan, the importance of improving the health of India was recognized however funding for health services was limited.<sup>386</sup> The first five-year plan allocated funding to medical education, medical training, and hospitals with plans to increase the number of doctors, nurses, compounders, hospitals and dispensaries available. The plan's goal was to increase hospitals by 2.4 per cent, dispensaries in urban areas by 24.8 per cent, doctors by 11.1 per cent, nurses by 35.6 per cent, and compounders by 81.3 per cent. Although the total numbers were low relative to India's population, the right steps were being taken to rehabilitate and develop the state of healthcare, which, as Chapter 2 noted, needed a great deal of improvement.<sup>387</sup>

Furthermore, the electorate in India prioritized providing for tangible benefits like electricity, factories, food, and roads. Therefore, the first-five year plan allocated funding for agriculture, irrigation, transportation, and power to build the foundation of the new country.<sup>388</sup> Ordinary Indians had direct contact with newly elected political figures and credited them for the appearance of these tangible items. Thus, whilst autocratic regimes in East Asia like China were able to launch successful medical technology campaigns such as vaccinations, democratic India,

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<sup>385</sup> *ibid.*

<sup>386</sup> India's Planning Commission, First Five-Year Plan, Part 3, Chapter 32 – Health.

<sup>387</sup> *ibid.*

<sup>388</sup> India's Planning Commission, First Five-Year Plan, Part 1, The Five Year Plan in Outline.

always at the mercy of a fickle electorate, took many more years to do the same. India's challenge with the electorate was addressed in a 2005 World Bank policy paper by Monica Das Gupta that underlined just how difficult it was to 'sell a public health success.'<sup>389</sup>

The lack of funding led to the decrease of routine public health services. For example, in West Bengal state, there were very few Sanitary Inspectors and across the country, male health workers were needed.<sup>390</sup> Gupta's points are substantiated in this period of post-colonial public health history, as the original underfunding of the Indian Health Service was eventually cut even further.<sup>391</sup>

## **II. The Influence of Medical Missions on Medical Technology**

Despite – or perhaps because of – pervasive funding cuts, the early post-colonial government put considerable effort into strengthening the role of the centre in health policy. The policy of federal centralization had considerable implications on the development and distribution of medical technology resources across the country. And, as this chapter will demonstrate, it was intimately related to the emergence of a popular new political force in democratic India – the Hindu religious elite – which flexed its muscles to undermine the perceived threat from Christian Missionaries. The perhaps inadvertent result of this policy was to reduce the availability of medical technology to some of the most vulnerable populations in India.

One significant sector with the potential to provide a substantial amount of medical technology during the early period of India's development was the Christian mission.<sup>392</sup>

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<sup>389</sup> M. Das Gupta, 'Public Health in India: An Overview', *World Bank Policy Research Working Paper*, (3787) (2005). Accessed at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=873895](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=873895).

<sup>390</sup> *ibid.*

<sup>391</sup> 'India's Health Budget Cut', *Times of India*, 10 November 1949, p. 9.

<sup>392</sup> Letter from The Right Reverend F.J. Western, 19 March 1948, Oxford, Bodleian Library. In this correspondence, there are numerous references to the medical technologies that the Christian Missionaries acquire, utilize, and dispense with their patients.

Missionaries from many developed countries, especially the UK and US, had historically played an important role in delivering medicine and medical technology to India, filling some of the gaps left by the British administration. Upon taking power in August 1947, the new government issued no formal proclamations informing the missionaries of any policy changes. These changes were, rather, slowly revealed through a series of ad-hoc encounters with missionaries that resulted in a series of policies that were counter-productive from a medical standpoint. Instead of trying to increase the diffusion of medical technology to aid the millions in need of vaccinations and treatments for dengue, India's secular government instead chose to use medical missions as a political chip through which to gain favour with the religious nationalist movement that had taken hold of the country.<sup>393</sup>

The missionaries' use of medical technology was both a quick way for the government to make an example of the Christian community and, through import taxation, another way to generate funds for a government hungry for revenue. Rather than continue to allow the missions to provide their services, the government denied much-needed medical supplies and technologies from entering the country and assisting many of its poorest citizens.<sup>394</sup> Although the medical missions were generally established and managed by non-Indians, they had long been a part of the fabric of the Indian medical mainstream.<sup>395</sup> The principal aim of European and North American missionaries was to convert Indians to Christianity, and medicine played an increasingly important part in this goal. Some missionaries portrayed paganism as a disease affecting the physical and mental wellbeing of the 'heathen'. These ideas contributed to notions

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<sup>393</sup> S. Khilnani, *The Idea of India* (New Delhi, 1999), p. 180.

<sup>394</sup> *ibid.*

<sup>395</sup> Before 1813, the British had banned Christian missionaries in India. They relented only as a consequence of strong evangelical pressure and, perhaps even more so, 'because many evangelical administrators came to believe that the existing relation of the subcontinent acted as a profound barrier to the thoroughgoing modernisation of its peoples.' Hardiman, *Missionaries and their Medicine*, p. 38.

of native peoples as a source of moral and physical contamination. Thus, as Hardiman has noted, ‘any Godly person who understood the rudimentary principles of hygiene and sanitation was in a position to bring health to the “native” by cleansing their bodies with soap and their minds with the Gospel’.<sup>396</sup>

Thus, missionaries in India aimed to help the ‘native peoples’ spiritually as well as hygienically. The missionaries’ condescending attitude toward ordinary Indians, who were often regarded as less than ‘Godly’, was at odds with a fast-moving political landscape that had shifted from autocracy to democracy in the space of just a few years. Not only did power shift from those with whom the missionaries had generated long-term alliances through years of working relationships, but the political environment following independence and Partition was pervaded by religious nationalism. The air of ‘superiority’ exhibited by the missionaries likely only hastened what nationalistic sentiment would have eventually brought forth. The complex relationship between the medical missionaries and the new government was most evident in the former’s interactions with the Indian political elite. As Hardiman explains, gaining access to, a regional ruler was a gateway to the local population and their spiritual education.<sup>397</sup> Medical technology and supplies were one of the most effective ways for outsiders to gain favour with the political elite.

The leverage afforded by medical technologies in the autobiographical account of Sir Henry Holland, an ophthalmic surgeon who practiced in Afghanistan, Pakistan, and India. After 50 years treating eye diseases among Indians, Dr. Holland penned a book detailing the adventures, patient experiences, and social interactions he had during this time.<sup>398</sup> His account is a well-documented example of how medical missionaries became integrated within colonial

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<sup>396</sup> D. Hardiman, ed., *Healing Bodies, Saving Souls: Medical Missions in Asia and Africa* (London, 2006), p. 9.

<sup>397</sup> *ibid.*

<sup>398</sup> H. Holland, *Frontier Doctor: An Autobiography* (London, 1958), p. 228.

Indian society. As Holland's reputation as a doctor grew, his services were required by an ever growing circle of the ruling elite.<sup>399</sup>

Whilst practicing medicine in India, he influenced politicians and princes in ways that improved his public health mission he had undertaken in India, including training new eye doctors to spread the word of the gospel to the frontier. Medical missionaries insisted upon the right to work within foreign nations unimpeded, a demand to which their political and princely allies were forced to accede if they wanted the benefits that missions brought to their regions.<sup>400</sup> The power and reach of medical personnel in low resource countries was unprecedented, with even military leaders providing exceptional provisions to the missions so that their influence could help in 'keeping the peace' of the tribes in the frontiers.<sup>401</sup>

The links that missionaries had forged with local elites by August 1947 *could* have had a positive long-term effect, but their influence was often to be found within elements increasingly marginalized by the Nehru secularists.<sup>402</sup> Dr. Colin Valentine, for example, who had gained a base for himself after successfully treating a member of the Maharaja's household, was persuaded by the prince to remain as his personal physician. In this way, medical missionary work was combined with employment as a servant of the state. Hindu princes within an autocratic regime did not much care about their medical providers being Christian: they had long patronised an array of religious bodies and viewed the missionaries as merely one such group worthy of support. As Hardiman noted, 'in part, the princely rulers of Rajasthan appreciated the medical missionaries as they wanted trained Western doctors without having to provide any great

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<sup>399</sup> *ibid.*

<sup>400</sup> *ibid.*, p. 119.

<sup>401</sup> *ibid.*, p. 210.

<sup>402</sup> Hardiman, *Healing Bodies, Saving Soul*, p. 7.

outlay, and the mission doctors came at a bargain price'.<sup>403</sup> But the new central government, backed by fervent religious nationalism, was less open to the presence of foreign groups and took action against the missionaries. The next section will cover a series of events that took place during the first few years of self-rule and demonstrated the reduction of the missionaries' influence in newly democratic India.

### **III. Ad Hoc Policy Implementation: A New Import Tax on Technologies**

Though touted by Indian Health Service leaders, medical technology was not a priority in the highest levels of central government in the early years of the republic. Instead, medical drugs, supplies, and devices were a part of a larger struggle between modernists, who were attempting to bring India's public health into the twentieth century, and traditionalists, who were trying to maintain what they took to be the medical practices of the past three millennia. Although there was a significant interest from the United Nations, missionaries, and foundations in providing life-saving medical technologies to tens of thousands of people in need, much of it was resisted by the new government.<sup>404</sup> Moreover, medical technology was considered so marginal at the highest levels of government that the move to cut supplies by imposing taxes on imported technologies was carried out without fear of retaliation from the general public or even practicing health professionals. Thus, in its first few years of independence, India actually saw a reduction in medical technology compared to the colonial period. The medical technology policy that emerged not only lacked governmental direction and support, but actually stifled potential contributions from individuals, non-profits, and other nations.

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<sup>403</sup> *ibid.*

<sup>404</sup> 'Activities of Foreign Missionaries Condemned', *Times of India*, 6 April 1954, p. 8.

A good example of the shifts that took place in India during this period can be found in the form of the Society for the Propagation of the Gospel in Foreign Parts (SPG), a religious group that had invested significant time and resources into Indian healthcare during the colonial years.<sup>405</sup> Under British rule, the SPG had been actively involved in building hospitals and schools for the benefit of the neediest populations on the subcontinent.<sup>406</sup> Whilst treating and teaching Indian people, the SPG discussed issues of faith; over time, education and medical care became not only the protocol for performing God's work by reaching out to the neediest, but also became a valuable tool for recruiting new members for the Church.<sup>407</sup>

One of the SPG's standard practices for improving healthcare was to ship items such as ambulances, pharmaceuticals, laboratory instruments, and x-ray machines to their hospitals in India. Although there had been clear procedures for doing this in British India, following independence, the government implemented a new set of personnel, policies, and processes. Even with these changes, however, the first year of the new government saw no major issues in continuing to import these technologies to their health centres.<sup>408</sup> But in March 1949, the SPG General Secretary received a disturbing letter from Mr. B.C. Roberts, a manager at the London office of the Shipping and Passage Department of Grindlays Bank Limited, the SPG's export agent.<sup>409</sup> The letter explained that a September 1948 bale (a container weighing about 500 pounds) of hospital supplies had been held in lieu of duty. The shipping manager quoted the agents in Madras as declaring that 'a sum of Rs 125/10 was assessed and after referring the matter to Dr. Y'mans DeTeil of Nandyal, we were asked to pay the same. We cleared the goods

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<sup>405</sup> A.N. Porter (ed.), *The Imperial Horizons of British Protestant Missions, 1880-1914* (Grand Rapids, 2003), p. 18.

<sup>406</sup> *ibid.*

<sup>407</sup> *ibid.*

<sup>408</sup> Letter from Dr. Mary Gell, SPG, 25 July 1949, Oxford, Bodleian Library, USPG Papers, M502. Gell's letter stated that the Society had been sending out bales of free gifts to hospitals that it supported, and implied that there has not been an incident until September 1948.

<sup>409</sup> Letter from Grindlays Bank Limited, 21 March 1949, Oxford, Bodleian Library, USPG Papers, M502.

on 29–12–48 and received payment for our Bill for all charges from this gentleman.’ Roberts ended his letter by suggesting that the General Secretary contact the Office of the High Commissioner for India in London in order to gain an exemption for future imported items.<sup>410</sup>

Within a week of receiving the letter, the General Secretary of the SPG, Dr. Mary Gell, did just that, writing to Roberts at the India House in Aldwych, England on March 31, 1949.<sup>411</sup> In her letter, she described the contents of the bales as ‘hospital dressings, sometimes instruments, bed attire for patients, sometimes bedding, and quite often old materials that can be useful in dispensaries.’<sup>412</sup> She continued by pointing out that these items were for patients who did not pay for their care, and that, moreover, the import fees assessed were actually in excess of the real value of the shipped items. Gell concluded her letter in a cordial manner, and simply asked for a process by which SPG could obtain an import fee exemption.<sup>413</sup> On April 8, an assistant to the Assistant Trade Commissioner attached to the High Commission for India replied to Gell’s letter. In a terse one-paragraph response, N.D. Tangri stated that, ‘there are no customs regulations exempting import of this nature from customs duty.’<sup>414</sup>

Tangri’s declaration was hard to fathom, especially given that, until this point, the new government had continued the policies established under British colonial rule, which allowed medical technology free passage through the ports without tax. Tangri referred the matter to the Minister of Health in New Delhi, writing that, ‘they may consider granting some financial aid to

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<sup>410</sup> *ibid.*

<sup>411</sup> Letter from Dr. Mary Gell, SPG, 31 March 1949, Oxford, Bodleian Library, USPG Papers, M502.

<sup>412</sup> *ibid.*

<sup>413</sup> *ibid.*

<sup>414</sup> Letter from Office of the High Commissioner for India, Commerce Department, India Supply Commission, London, 21 March 1949, Oxford, Bodleian Library, USPG Papers, M502. This letter was written by N. D. Tangri, whose title states ‘For Assistant Trade Commissioner.’ *ibid.* On the header of the letter the Assistant Trade Commission is listed as N.V. Rao. *ibid.* This delegation to such a low level of the Commissioner’s office for such a response could suggest that either the Commissioner’s office was quite busy, or that they did not consider this issue significant, or that the issue could have been so significant that they wanted to create some distance from any leading figure. *ibid.*

meet the customs duty, provided a written undertaking is furnished that these supplies are meant for free use of all poor patients, irrespective of race, caste or creed.’<sup>415</sup> The mission’s confusion was understandable, given that the High Commission for India in London was preoccupied with trying to encourage large manufacturers and banks to invest in a country eager to join the international community. Moreover, the impact of the tax on the mission’s finances and core principles was devastating: the missionaries had to choose between ending their practice of saving bodies and souls or increasing their budget for providing drugs and other medical devices. And all of this occurred in an already-devastating import climate, as currency issues and administrative inefficiencies had created a drug shortage in India.<sup>416</sup>

Recognizing the critical situation, Gell took time to consult with numerous figures in both India and England before writing to the Minister of Health.<sup>417</sup> In a response to New Delhi sent July 25, 1949, Gell noted that the SPG ‘from time to time’ sent supplies to hospitals that it supported in India, describing the items in the same way as she had in her letter to the Office of the High Commission for India earlier in the spring. She then outlined the exorbitant fees charged for the items upon their arrival in India and concluded by inquiring as to whether a letter confirming the intent to use the items for ‘all poor patients, irrespective of race, caste’ should come from the SPG or from the recipient hospital.<sup>418</sup>

Almost three months later, Gell received a response from A.K. Bhatia, Under Secretary to the Health Minister. It is apparent from Bhatia’s letter that whilst the new government had charged customs on other donated medical technology over the first years of its existence, it had

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<sup>415</sup> *ibid.*

<sup>416</sup> Y.S. Kulkarni, ‘Drug Imports: To The Editor’, *Times of India*, 2 April 1948, p. 6.

<sup>417</sup> Letter from Dr. Mary Gell, SPG, 25 July 1949. Gell’s letter to the Health Minister is one page, or 243 words, and made out simply to the Minister of Health, with no specific name, suggesting that she did not know which person occupied the office, and giving an indication of a healthcare system in transition.

<sup>418</sup> *ibid.*

received little feedback questioning the rationale of such a policy.<sup>419</sup> Bhatia began by outlining the terms and conditions for the use of imported donations, noting that they could be utilised only for the ‘poor and the needy without any distinction of race, caste or creed.’<sup>420</sup> The donor of medical gifts, moreover, must ‘satisfy’ the Collector of Customs that the donated medical technology had, in fact, met the criterion of use.<sup>421</sup>

Although Under Secretary Bhatia excluded x-ray machines, laboratory devices, and ambulances from his policy, he appeared to deliver a death blow to an already wounded organization when he noted, ‘I am to add that exemption from customs duty is not admissible on instructment [sic] or such of the old material as is not of a consumable nature and is more in the nature of permanent or semi-permanent equipment’. The result of his statement was to drive a further wedge between medical missions and their duty-free status, as the SPG was primarily interested in shipping these non-consumable items. Bhatia’s final limitation on donated technology required the beneficiary hospital to submit an application for tax exemption to the Minister of Finance. This provision ensured some measure of accountability, requiring the importer to prove that the technology did in fact benefit populations in need, regardless of race, caste, and creed. As a whole these policies placed a significant procedural burden on an already overstretched medical system.<sup>422</sup>

Given the missionaries’ air of spiritual superiority and history of using medicine and medical technology to manipulate local political leadership, government intervention might have been expected. And, indeed, this seems to have been the basis on which the new government

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<sup>419</sup> This can be deduced from the fact that Bhatia did not reply with a form letter with an attached code or procedure that might exist, but rather wrote a personal, almost customised, missive specific to the situation.

<sup>420</sup> Letter from J. N. Saksena, Under Secretary, Minister of Health, 27 October 1949, Oxford, Bodleian Library, USPG Papers, M502.

<sup>421</sup> *ibid.*

<sup>422</sup> Y.S. Kulkarni, ‘Drug Imports: To The Editor’, p. 6.

implemented its unfavourable tax, despite the reduction in the quality of medical care across many parts of the new nation. The evidence of the exchange, especially the pause in the weekly letters, indicates that a more substantial thought process was taking place amongst the leadership. The fact that this delay coincided with the government's turn toward the religious nationalist movement leads one to conclude that the new tax was in large part a result of these new religious-political tensions. Import fees on medical technologies permanently reduced the size and scope of the medical missions in India and, more importantly for this work, weakened the embryonic medical technology by reducing the supply and distribution of medical technology for a significant segment of the Indian population. The new religious elite had found a way to exercise power, and the central government had found a way to exercise control: it was a match made in democratic heaven.

The new tax was a portent of things to come, as during the 1950s and '60s the Indian government became increasingly antagonistic toward non-native medical missionaries, which they associated with neo-colonialism. Nehru himself, in an address to the Lower House of Parliament in 1954, noted that, 'the Government [is] not in favour of adding to the already large number of foreign missionaries in the country because it [feels] the presence of too many foreigners created new problems.'<sup>423</sup> In the new India, the missionaries lacked a powerful political base that could influence the secular, central government and, in particular, overturn the central government's import tax policy. Visas were increasingly denied to missionaries, mission-run institutions were closely monitored with regard to funding, and missionaries found it difficult to receive clearance for medical technologies and supplies. Political antagonism often spread to the general populace, with missionaries attacked without provocation.<sup>424</sup>

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<sup>423</sup> 'Missionaries Facing New Curbs in India', *New York Times*, 19 May 1954, p. 4.

<sup>424</sup> 'English Doctor & Nurse Killed', *Times of India*, 25 November 1947, p. 7.

In the two years following independence, the post-colonial government laid the foundation for a future without medical missions. It was during this period that the government began to develop its own network of Primary Health Centres, which were often in direct competition with the mission hospitals. As a result, the latter had to choose between closure and transition into entirely indigenous organisations, staffed and financed by Indians.<sup>425</sup> The medical missions were destined for a significantly reduced role, not only in the country's spiritual path, but also in their ability to introduce state-of-the-art medical technology. Thus, we can see that the issuance of a new import tax was not an indiscriminate ruling, but part of a larger policy by a newly-engaged political leadership to increase Indian medical self-reliance whilst also eliminating foreign missions and their Western technology. The deliberate policy of taxing medical imports had nothing to do with the well-being of thousands of patients but was instead an effort by the central government to appease an emerging religious-political force, centralize power, and raise revenue. In the wake of the government's decision, India launched itself on a course that would impact on the role of medical technology and medicine for the next decade.

#### **IV. Prioritizing Public Health Needs within a New Nation**

As the new government came together, the rivalry between India's various administrative levels – central, state, and local – became increasingly tense. As discussions in meetings and correspondence in Spring 1948 indicate, it became clear that medical technology would fall under the auspices of the central Health Services, the body that had been given oversight for the drug and medical device sectors.<sup>426</sup> As the country had moved toward independence in the years leading up to 1947, there had been little effort to build up the Congress Party on a local level; as

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<sup>425</sup> Hardiman, *Healing Bodies, Saving Souls*, p. 21.

<sup>426</sup> Letter from Jivraj Mehta, Secretary of the Health Ministry and Director General of Health Service to G. S. Rau, Government of India Economy Committee.

a consequence, much of the public health efforts remained in control of the ‘dominant land-owning castes’.<sup>427</sup> This kind of local control over public health programmes was a significant concern to the central government. As the Congress party learnt how to consolidate its power and build its political base, the Health Minister, Amrit Kaur, became a master of broad-based communications designed to redistribute power from local to the central level. In public rallies, for example, she stated that ‘education was power,’ and that healthcare should be available for all peoples.<sup>428</sup>

The centralizing tendencies of the Congress Party were apparent from early exchanges between the leadership of the Health Minister’s office, the Director of the Health Service, and the head of the Committee on the Economy. In one report, under the heading of ‘Scope of Central Responsibility’, Kaur spoke of the new Federal Centre as follows:

It cannot be strong unless it is also vigorous in action. Over the whole social and economic field, the people and their representatives, whether in the Centre or in the Provinces, eagerly await dynamic movement rather than static inertia. It is difficult, therefore, to foresee how over the whole field of state activity there can be any reduction which would in any significant measure, reduce the demand for trained man power. Education, health, agriculture, to name a few subjects which are constitutionally classed as “Provincial” have ceased to be treated in any progressive country possessing a Federal Constitution as matters of purely Provincial concern. They present many national problems which admit of a satisfactory solution only on the basis of an active partnership between the Federal and “Provincial” or “State” Governments.<sup>429</sup>

It was apparent from this report that tensions were already felt between central, state, and local governments, with the central leadership demarcating the areas perceived as critical for national authority, in this case, education. This was only the first of numerous speeches that addressed health and medical education without offering substantive funding. Reporting on an

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<sup>427</sup> Frankel, *India’s Political Economy*, p. 22.

<sup>428</sup> ‘Practical Value of Freedom’, *Times of India*, 27 January 1948, p. 3.

<sup>429</sup> ‘Second Annual Health Minister’s Report’, August 1948, NAI (Box 192).

address to a group of students at the Nair College Dental School in Bombay in February 1948, the *Times of India*'s précis of Health Minister Rajkumari's speech noted that, 'it was not proper' to expect the Central Government's aid in health services as it was primarily a 'provincial subject'.<sup>430</sup> As we will see in Chapter 5, during the period of the eradication of smallpox much of the medical technology continued to not only come from abroad, but was also funded from outside sources following the realisation that the world's largest democracy would become unstable without foreign support. .

It was not until two years later, in March 1949, that the central Health Ministry was able to clearly assert its authority, sending a letter to the Committee on the Economy demanding funds for the minimum staffing required by the Health Ministry. The Ministry not only outlined each position it required but also detailed its primary policy functions:

The degree of influence which a Central Health Ministry can exert in the matter of improvement of health administration throughout the country will depend entirely on the extent to which it can initiate enquiry, discussion, and experiment, and the extent to which it comes to be looked upon by provincial administration and the professional and the lay public as an organisation which is competent to advise and assist in the practical solution of health problems.<sup>431</sup>

The letter continued with a detailed description of the twelve functions of the Central Ministry of Health, which had the effect of laying out a path for the development of medical technology over the next 44 years.<sup>432</sup> This included accountability and administration of services, promotion of research, enforcement of standards, and collation of information as regards all health issues, and, especially, advancement and maintenance of the new health service to a high standard.<sup>433</sup> There

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<sup>430</sup> 'Centres to Help Health Services', *Times of India*, 21 February 1948, p. 5. 'Provincial subject' is here a direct quotation from Rajkumari's speech.

<sup>431</sup> Letter to the Committee on the Economy, Box 158, March 1950, NAI.

<sup>432</sup> *ibid.*

<sup>433</sup> *ibid.*

were, however, a number of points yet to be debated in relation to the Health Ministry's authority.

## **V. Conclusions: A Prelude to a Policy for a New Country**

As this chapter concludes, it is important to remember the chaos and mayhem that ensued during Partition and that the corresponding transfer of power from the British to the Indians was evident not only on a human level, with interpersonal violence, but also at the policy level. We have seen an account of the new tax policies put forth by factions of the centralized government and the budgets of the early government, both of which indicate how much attention politicians gave to the population's public health needs, particularly those in dire need of medical assistance. Whilst there were high ideals in speeches, in practice these were often muddled in economics, intra-state politics, and religious-inspired nationalism.

The early years of medical technology were substantially shaped by the elite in democratic India. It was clear that medical technology development in the new Indian nation was buried below many other issues, including the establishment of a viable political structure, general economy, legal system, manufacturing base, national transportation network, and an educational system. The development of the medical technology infrastructure, which lay in ruins following World War II and the violence of Partition, further regressed following the implementation of levies on the medical missionaries. For whilst the missions had made inroads for nearly a century by creating strong alliances with political elites such as princes in Rajasthan and generals in Delhi, those alliances, based on an autocratic model of governance, gave them few advantages in the new, secular democracy. Nor did such relationships allow the missionaries unimpeded use of medical technology following the new policies introduced by the post-colonial

leadership in 1948. In Chapter 4 we will examine the ways in which a medical technology infrastructure developed despite both a lack of financial resources and government stewardship.

The lack of clarity and direction for the use of medical technology in the initial years of post-colonial India should not be overlooked. Disorder and disarray concerning the role of medical technology and, to a smaller degree, public health and medicine abounded. As noted earlier in the chapter, the priority attached to developing a health policy and its corresponding medical technologies was far lower than the need for a viable currency, national defence, and transportation. These legitimate concerns negatively impacted the early growth of medical technology in India, the development of which was scattered with inconsistent quality and vigour amongst discrete pockets of public health groups, hospitals, and clinics managed by government agencies, and international non-profit and various religious organisations. It was only on rare occasions that the attention of a lower level government bureaucrat fell upon the area of medical technology. Nevertheless, by 1949, the role of the Central Health Ministry had greatly evolved and now encompassed any major issues within the purview of responsibilities listed above.

Later in this thesis, we will see that after India formed a relationship with the Soviet Union and the West moved to punish it financially for expressing technological autonomy, the Indian government took the bold move of reducing taxes. As a result of its efforts to counter the economic disparities on medical technology import levies, India suffered substantial international isolation. As we will see, India leveraged medical technology as a low cost alternative to the West across global markets. India was no longer beholden to the West.

## Chapter 4: Developing Infrastructure and Institutional Support – 1952 to 1963

One thing is clear to me: that if we do not develop heavy industry here, then we either eliminate all modern things such as railways, airplanes and guns, as these things cannot be manufactured in small-scale industry, or else import them. But to import them from abroad is to be the slaves of foreign countries. Whenever these countries wished they could stop sending these things, bringing our work to a halt; we would thus remain slaves.

– Prime Minister Jawaharlal Nehru <sup>434</sup>

During the 1950s, Prime Minister Nehru aimed to bring ‘economic independence’ to India.<sup>435</sup> He stated that ‘it is essential for us to have many industries, for we cannot build up a sound economy and be independent of other countries without developing a good number of heavy industries.’<sup>436</sup>

As in the period considered in the previous chapter, therefore, the development of medical technology was not a high priority for post-independence India. Relative to the country’s need to develop strength in agriculture, industry, transportation, and defence, medical technology was far from a prime concern. Although scattered elements of a medical technology industry were already present in India, in the five years following independence, the base that had been assembled during the colonial era was not sufficient to sustain the nation’s growing population. Most patients in India still relied on medical devices, supplies, and pharmaceuticals from the outside world. In fact, imports accounted for nearly all of the medical technology usage by India’s public health system until the 1970s.<sup>437</sup>

Alongside a discussion of the influence of the international medical technology complex, this chapter will demonstrate how the development and production of healthcare technologies such as medical devices and pharmaceuticals accelerated in the years between 1952 and 1963.

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<sup>434</sup> In a speech delivered in March 1953 at the Federation of Indian Chamber of Commerce and Industry (FICCI). Quoted in A. Panagariya, *India: The Emerging Giant* (New Delhi, 2008), p. 25.

<sup>435</sup> *ibid.*

<sup>436</sup> *ibid.*

<sup>437</sup> ‘Plan to Develop Drug Industry: Minister Meets Soviet Experts’, *Times of India*, 6 August 1958, p. 7.

By the end of the decade, healthcare technology emerged as not only a vital section of the Indian economy, but as one of the primary weapons in its diplomatic arsenal.

By the start of the 1950s, it had become clear that India needed to focus more on public health. Health Minister Rajkumari Amrit Kaur addressed an audience of physicians in Poona (Pune) on February 3, 1952 and announced that the federal government was developing a scheme to aggregate a large pool of medicines, primarily antibiotics, to be stockpiled over the next year.<sup>438</sup> She also noted the establishment of a new postgraduate school for medical education, eventually known as the All India Institute of Medical Sciences (AIIMS), the origins of which we will examine later in the chapter.

One of the most significant developments during this period was India's policy of non-alignment. Taking advantage of a polarized political situation, and especially the West's fear of the so-called 'domino principle', India received aid, medical loans, and donations from governments, corporations, and foundations aimed at enhancing the geopolitical influence of both the West and the Soviet bloc. This aid was vital to the development of India's medical technology industry; as we will see, the geopolitics of the early Cold War contributed directly to the foundation of AIIMS, among other institutions.

## **I. Early Government Efforts in Industrial Development**

As Indian democracy slowly began to take shape in the 1950s, it faced substantial social and political upheavals.<sup>439</sup> After half a decade of independence, India's political structures had yet to stabilize. The country faced severe over-population and unemployment and was trying to bring

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<sup>438</sup> 'Central Pool of Medicines: Minister's Proposal', *Times of India*, 4 February 1952, p. 3.

<sup>439</sup> T. Zinkin, 'India's New Violence: After a Social Eruption', *Manchester Guardian*, 25 July 1956, p. 6.

jobs to a nation that remained predominantly rural.<sup>440</sup> Both the Indian National Congress and the Communist Party of India were splintering into factions.<sup>441</sup> Meanwhile, the nation was also trying to avert a war with Pakistan; as President Rajendra Prasad stated on the eve of the fourth anniversary of independence, ‘There are threatening and heavy clouds on the borders of our country’.<sup>442</sup> One significant threat to the integrity of the nation was the poor state of public health.

In order to achieve its development goals, India was moving toward finalizing its first five-year plan, a policy-making structure borrowed from the Soviet Union.<sup>443</sup> India’s policy provided many domestic benefits, including access to capital for industrialization and the creation of export markets for the economy. As we will see, India’s the relationship with the Soviet Union became very important during this period, particularly as a way of drawing more aid from the West. Each additional visit from a communist bloc official was swiftly followed by increased agricultural, military, and medical technology aid from free-market, democratic nations.<sup>444</sup> Indeed, India’s policy of non-alignment allowed the subcontinent to receive aid from both the Soviet bloc and the US and its Western allies without committing itself ideologically to either.<sup>445</sup> The policy was to become one of the foundational components of India’s eventual emergence as a medical technology superpower, as it allowed them to court the attention and resources of both players in a heavily polarized world.

The spring of 1952 brought the implementation of the first five-year plan. The government initially started planning the programme in 1950 and approved the policy in 1951. A

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<sup>440</sup> R. Stephens, ‘Russian Activity in India’, *The Observer*, 22 April 1951, p. 3.

<sup>441</sup> R. Trumbull, ‘India Faces Crisis on 4th birthday’, *New York Times*, 16 August 1951, p. 3; Stephens, ‘Russian Activity in India’, p. 3.

<sup>442</sup> Stephens, ‘Russian Activity in India’, p. 3.

<sup>443</sup> M.R. Masani, *The Communist Party of India: A Short History* (New York, 1954).

<sup>444</sup> ‘Indian Policy in Foreign Affairs: Avoiding Rival Blocks’, *Manchester Guardian*, 18 September 1950, p. 8.

<sup>445</sup> *ibid.*

sum of 140 crores, or 5.9 per cent of the total domestic budget, was allotted for public health programmes.<sup>446</sup> In this context, the Indian government was spending more on healthcare than nearly all other developing nations, which typically spent 1 to 3 per cent. Thus, whilst public health was not India's first priority, it still received significant attention relative to comparable countries.

INDIA'S FIVE YEAR PLANS			
<i>Table 1</i>			
DISTRIBUTION OF PLAN OUTLAYS BY MAJOR HEADS OF DEVELOPMENT*			
	First Five Year Plan	Second Five Year Plan	
	Per cent	Per cent	
Agriculture and Community Development . . . . .	15.1	11.1	
Irrigation and Power . . . . .	28.1	19.1	
Industry and Mining . . . . .	7.6	18.5	
Large and Medium Industries . . . . .	6.3	12.9	
Mining Development . . . . .		1.5	
Village and Small Industries . . . . .	1.3	4.1	
Transport and Communication . . . . .	23.6	28.9	
Social Service . . . . .	22.6	19.7	
Education . . . . .	7.0	6.4	
Health . . . . .	5.9	5.7	
Housing . . . . .	2.1	2.5	
Welfare of Backward Classes . . . . .	1.3	1.9	
Social Welfare . . . . .	0.2	0.6	
Labor Welfare . . . . .	0.3	0.6	
Rehabilitation . . . . .	5.3	1.9	
	3.0	2.1	
	Total 100.	Total 100.	

Table 4: The Development Spending in India for the First Five-Year Plan<sup>447</sup>

The effort to expand the scope of the public sector and incorporate socialist policies was one of the government's goals during this time.<sup>448</sup> The first five-year plan stated that,

The scope and need for development are so great that it is best for the public sector to develop those industries in which private enterprise is unable or

<sup>446</sup> J.E. Park, *Textbook of Preventive and Social Medicine: A Treatise on Community Health*, (3rd ed.) (Prem Nagar, 1972).

<sup>447</sup> India's Planning Commission, Second Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

<sup>448</sup> Panagariya, *India: The Emerging Giant*, p. 33.

unwilling to put up the resources required and run the risk involved, leaving the rest of the field free for private enterprise.<sup>449</sup>

In 1956, the Industrial Policy Resolution (IPR) of 1948 was amended to reflect these priorities.<sup>450</sup> The 1956 incarnation of the IPR contained three schedules for each category of industry created. Schedule A listed 17 industries, including mining and air transport, for which the state was to have ‘exclusive right of new investment.’<sup>451</sup> The private sector was permitted to operate in 12 industries, including minerals, chemical industries, synthetic rubber, and sea transport, all of which were listed in Schedule B.<sup>452</sup> Even here, however, the state could also compete in these industries. Finally, Schedule C listed the remaining industries that were to be developed by the private sector, though once again the state had the right to enter these industries. The public sector thus took a prominent role in the new nation’s economy.

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<sup>449</sup> *ibid.*

<sup>450</sup> Panagariya, *India: The Emerging Giant*, p. 33.

<sup>451</sup> Department of Industrial Development, Ministry of Industry: Exhibit No. 1, Industrial Policy Resolution, 30 April 1956, p. 5.

<sup>452</sup> Panagariya, *India: The Emerging Giant*, p. 33.

EXHIBIT NO. 1 (Contd.) INDUSTRIAL POLICY RESOLUTION (30th April, 1956)	
SCHEDULE-A	
1.	Arms and ammunition and allied items of defence equipment.
2.	Atomic energy.
3.	Iron and Steel.
4.	Heavy castings and forgings of iron and steel.
5.	Heavy plant and machinery required for iron and steel production, for mining, for machine tool manufacture and for such other basic industries as may be specified by the Central Government.
6.	Heavy electrical plant including large hydraulic and steam turbines.
7.	Coal and lignite
8.	Mineral oils.
9.	Mining of iron ore, manganese ore, chrome-ore, gypsum, sulphur, gold and diamond
10.	Mining and processing of copper, lead, zinc, tin, molybdenum and wolfram.
11.	Minerals and specified in the Schedule to the Atomic Energy (Control of Production and Use) Order, 1953.
12.	Aircraft.
13.	Air transport.
14.	Railway transport.
15.	Ship Building.
16.	Telephones and telephone cables, telegraph and wireless apparatus (excluding radio receiving sets).
17.	Generation and distribution of electricity.

Table 9: The 17 sectors that the Indian Government Included in Central Planning <sup>453</sup>

Conceived as an attempt to centralize what had previously been a nation of more or less autonomous states, ‘planned’ development was seen as the only means to stabilize the political situation in India and reduce the level of malnutrition around the country. It was also designed to improve national security, which was threatened by Pakistan to the west and China to the north. More specifically, in the period 1952–63, India attempted to transform its economy from a rural agrarian to a market-oriented industrial one.<sup>454</sup> Looking to countries like Japan and the Soviet Union, India saw examples of both free-market and state-controlled economies that were growing much more quickly than its own.<sup>455</sup> Despite the crushing economic and human toll suffered by both countries during World War II, Japan, and the USSR – unlike India – had a

<sup>453</sup> Department of Industrial Development, Ministry of Industry, p. 5.

<sup>454</sup> S. Kuruvilla, ‘Linkages Between Industrialization Strategies and Industrial Relations/Human Resource Policies: Singapore, Malaysia, the Philippines, and India’, *Industrial and Labour Relations Review* (1996), pp. 635–57.

<sup>455</sup> ‘Study of Pharmaceutical Production in Russia: Indian Delegation’s Tour’, *Times of India*, 10 August 1956, p. 11.

history of independent, nationalistic economic institutions that allowed education, manufacturing, and international trade to develop strongly.

Bolstered by firm government support, the movement toward the industrialization of India's medical technology saw early success. In the period 1952–6, production rose roughly 30 per cent, from 11 crore rupees in 1952–3 to about 15 crore rupees in 1955–6.<sup>456</sup> This increase was predominantly due to the improvement of several new vaccines aimed at infectious disease, such as polio and smallpox. But despite the growth of Indian medical technology in the specific field of penicillin manufacturing, the construction of facilities for the production of most medicines was still largely dependent on imported equipment. Nevertheless, India's manufacturing leaders and engineers gained considerable knowledge, experience, and expertise in the relevant manufacturing processes during this period. The subsequent increase in demand for labour in the areas of medical device and pharmaceutical development and production, as well as the growth in the talent and quality of this labour, was a key element in the expansion of India's medical technology industry over the next forty years.

One of the main obstacles the Indian government faced in implementing the first five-year plan was a result of the nation's colonial heritage. Although it had been half a decade since India achieved independence, the economy was still struggling to transform from one that had been geared toward the economic priorities of Great Britain. Britain's exploitation of India's natural resources, agriculture, and labour has been well-documented in the literature over the past 50 years. Chandavarkar and others have shown the various means by which colonial India was exploited as it developed industrially: 'It was not so much the continuous application of new techniques which characterized the growth of the industry in India as much as relentless improvisation in the use of old machinery, the manipulation of raw materials and the exploitation

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<sup>456</sup> *ibid.* Crore is the sum of ten million in India.

of cheap labour'.<sup>457</sup> The result was that the new republic lagged behind other industrial economies recovering from World War II, such as the Soviet Union, Germany, and Japan.<sup>458</sup> India had only two per cent employment and seven per cent GDP from manufacturing in 1947, for example.<sup>459</sup>

Great Britain inhibited the emergence of an industrial base in India for two reasons. Firstly, it did not want to create a competitor to products made in the British Isles. Moreover, and relatedly, it was trying to create a foreign market for British products.<sup>460</sup> Thus, in the years prior to the first five-year plan and the emergence of industrialization, India possessed a rudimentary economy, an enormous and under-resourced population, strained relations with its neighbours, and an economy explicitly conceived to export its raw goods. In order to stabilize the health of its population, the government planned to expand India's agricultural productivity, which, it was hoped, would result in nutritional self-sufficiency.<sup>461</sup> In just a single year (1952) during this period, however, India's natural reserves shrank from \$1.5 billion USD to \$1 billion USD as a result of substantial capital reserve investment in its industrial base. The result of this drastic shrinkage was that it became difficult for the new nation to acquire sufficient machinery to build more factories.<sup>462</sup>

As the 1950s turned into '60s, there had been considerable progress toward India's goal of becoming self-sustaining in the areas of mining and manufacturing, which stimulated growth of the medical technology industry. The growth target set by the Planning Commissions in 1951–

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<sup>457</sup> R. Chandavarkar, 'Industrialization in India before 1947: Conventional Approaches and Alternative Perspectives', *Modern Asian Studies*, 19 (3) (1985), p. 650.

<sup>458</sup> *ibid.*

<sup>459</sup> K. Akamatsu, 'A Historical Pattern of Economic Growth in Developing Countries', *Developing Economies*, 1 (s1) (1962), p. 7.

<sup>460</sup> Chandavarkar, 'Industrialization in India Before 1947', p. 650; B.R. Tomlinson, *The Economy of Modern India: From 1860 to the Twenty-First Century*, Vol. 3 (Cambridge, 2013), p. 80.

<sup>461</sup> Chandavarkar, 'Industrialization in India before 1947', p. 650.

<sup>462</sup> *ibid.*

2 had almost been reached; indeed, about 85 per cent of its targets had been met by the end of the second plan.<sup>463</sup> Under pressure from a newly enfranchised population, the goal of self-sufficiency was extended to include vaccinations, antibiotics, and other medical technologies. Public scrutiny also played a key role in driving the demand for more and better medicines, devices, and medical supplies, such as vaccines, X-ray machines, and wheel chairs.

Healthcare services were also one of the key themes in political discourse throughout the 1950s: as the speeches and editorials of the time reveal, issues of health dominated elections and public debate. In July 1957, for example, there was a debate in the Lok Sabha (lower house of the Indian Parliament) in which the public demanded more doctors, nurses, midwives, hospitals, clinics, and sanatoria. They were also said to clamour for a '[g]reater alliance on the indigenous systems of medicine and for self-sufficiency in modern drugs.'<sup>464</sup> This push by the electorate helped to focus government efforts to industrialize India's medical manufacturing facilities. Adequate healthcare was starting to become a matter of political expediency, forcing Indian politicians to deliver tangible improvements to the healthcare system as a whole.

Sanitex, a pharmaceutical company and life sciences manufacturer established in 1946, is a good example of the improvements in India's medical technology capacity, and industrial complex more generally. In Sanitex's first few years of operation, the company faced numerous difficulties related to its production capacity, including a lack of raw materials, building supplies, general manufacturing equipment, and adequate transportation. However, the situation quickly improved: between 1948 and 1954, the company added new medical advisors, pharmacists, biochemists, chemists, and other technicians to its payroll. As an article of June 1955 revealed, improved transportation and access to raw materials following World War II saw the company's

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<sup>463</sup> W. Malenbaum, 'Industrialization in India's Development', *Wilfred Current History*, 44 (259) (1963), p.169.

<sup>464</sup> 'Health Services', *Times of India*, 31 July 1957, p. 6.

access to supplies improve, allowing its growth to accelerate.<sup>465</sup> As a result, Sanitex expanded substantially, increasing from four lakhs per annum in revenue to 15 lakhs per annum in 1948–54, or approximately \$231,000 USD in total growth over a six year period. That a small manufacturer like Sanitex experienced such a tremendous increase in growth was indicative of the rapid expansion of India’s medical technological base.

Meanwhile, the government used drugs and vaccines to improve public health. Over the course of the 1950s, the state-owned Hindustan Antibiotics Limited developed a plant in Pimpri that was able to produce massive amounts of penicillin, with the goal of making India self-sufficient in its production. In 1954, the production of drugs in India had greatly improved, but there was an overall lack of indigenous supplies for several basic chemicals, including reagents and solvents like ethanol alcohol.<sup>466</sup> The article concluded by noting that the establishment of the penicillin factory aimed at reducing India’s dependence on pharmaceutical imports. As late as 1959, the *Times of India* reported that the same factory had increased its production of penicillin from 29 million mega units to 40 million mega units in a single year. In an interview, the head of Hindustan Antibiotics, T. Raja, stated that the goal was for India to become independent in the production of penicillin by the end of the 1960s.<sup>467</sup>

Thus, India’s manufacturing capacity grew from near-total dependency on imported penicillin in 1950 to self-sufficiency by 1970.<sup>468</sup> Hindustan Antibiotics’ success is an illustration of the federal government’s ability to respond to the public and meet the demands of the health system. In October 1952, the Indian government formed the Central Consul of Health to help coordinate and align healthcare policies between the state and federal government in New

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<sup>465</sup> ‘A Decade of Sanitex: Progress’, *Times of India*, 30 June 1955, p. 12.

<sup>466</sup> ‘Production of Drugs’, *Times of India*, 26 May 1954, p. 13.

<sup>467</sup> A. Egerton, ‘Scientific Research in India’, *Journal of the Royal Society of Arts*, 103 (1955), p. 809.

<sup>468</sup> S. Bhattacharya, *Expunging Variola: The Control and Eradication of Smallpox in India*, (Hyderabad, 2006).

Delhi.<sup>469</sup> The establishment of the Central Consul of Health attested to the government's growing understanding of the quantity of resources needed to meet the country's massive healthcare needs. As the local, state, and federal government groups began to align their interests, momentum for coordinated public health programmes grew, as did domestic demand for medical technology.

## **II. The Development of Medical Education and the Role of Foreign Aid**

For all its industrial success, however, it became increasingly clear that India's educational system, including its provisions for medical education, was under-resourced. Improving the institutions in both secondary and higher education was essential, and to do so would require substantial funding.<sup>470</sup> A strong educational system is at the core of any medical technology industry: as the source of innovation and development, having sufficient clinicians to both care for the sick and innovate the next generation of technologies is fundamental to potential growth.

In pursuit of this goal, the government formed a committee, led by Dr. Iakshmanaswami Mudaliar, the Vice-Chancellor of the University of Madras, charged with developing a plan to establish an 'All Indian Institute of Medical Sciences...the primary object of which will be to provide higher postgraduate training and research in all branches of medicine.'<sup>471</sup> Many within the new government saw such an institute as the cornerstone of the modernization effort of Indian healthcare, a place where the best physicians in the country would be trained and before being dispatched across the country to train others. Given the paucity of India's scant resources and large population, a 'train the trainer' model was the only one that allowed healthcare to spread

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<sup>469</sup> *ibid.*, p. 36.

<sup>470</sup> India's Planning Commission, Second Five-Year Plan.

<sup>471</sup> Letter to the Secretary to the Government of India, Ministry of Health, from the Director General of Health Services, 11/03/1948, NAI.

across such a diverse geography.<sup>472</sup> Their approach was given a push by the government's negotiation of a £250,000 GBP grant from New Zealand to finance the building of the Institute.<sup>473</sup> The deal was financed through the Colombo plan, which was created by the Commonwealth in 1950 as an aid-for-barter system to assist developing Asian countries.<sup>474</sup> The plan eventually included considerably more funding for healthcare, infrastructure, and medical technology.<sup>475</sup>

The All-Indian Institute was the first large project in which almost the entire budget came from foreign aid, but it was far from the last. The whole of the Indian government, including the leadership of the Indian Health Service, understood the dynamics of international politics at the time. As World War II had ended, new lines were drawn; following a bloody civil war, China had become the first major post-war power to move over to the communist side. The rise of communism in China and the Soviet annexation of Eastern Europe heralded a new, realist approach to international relations within Western Europe, the Commonwealth, and the United States. As such, when India embraced democratic rule in 1947, capitalist governments and organizations such as the Rockefeller and Ford foundations began sending aid in the hope that economic support would help prevent India from becoming the next China.<sup>476</sup>

The primary mission of foundations like the Rockefeller and the Ford was in the fields of healthcare and education. Both had been present in pre-Independence India trying to develop vaccinations for malaria, typhus, and yellow fever.<sup>477</sup> Following World War II, the Rockefeller Foundation (RF) expanded its global agenda, primarily due to increased global communication

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<sup>472</sup> 'Move For All-India Medical Institute At Delhi: Rajkumari Amrit Kaur on Scope of Dentist's Bills', *Times of India*, 20 February 1948, p. 7.

<sup>473</sup> AIIMS Archives, <http://www.aiims.edu/aiims/ritact/AIIMS-ACT-RULES.pdf>.

<sup>474</sup> 'Colombo Plan for development of Asian Countries: India To Incur Major Expenditure', *Times of India*, 29 November 1950, p. 1.

<sup>475</sup> *ibid.*

<sup>476</sup> L. J. Friedman, *Charity, Philanthropy, and Civility in American History* (Cambridge, 2004), p. 320.

<sup>477</sup> J. Farley, *To Cast Out Disease: A History of the International Health Division of Rockefeller Foundation* (Oxford, 2004), p. 66.

and transportation routes. Originally, the RF's primary concern was the implementation of cutting edge research in medical technologies in the form of vaccinations and immunisations, which necessitated training teams of doctors, nurses, and public health workers charged with administering these programmes. With India's shift to independence, the Foundation set about trying to push the Indian Health Service's decision-making toward principles and actions the Foundation considered most appropriate, including the use of scientific expertise, modern management, and applied technology.<sup>478</sup> In a major blow against the Indian Health Service leadership, the Foundation lobbied against India's plan to fund the creation of the All Indian Institute of Medical Sciences (by then known as the All Indian Medical Institute), instead recommending that the money be used to improve existing facilities around the country.<sup>479</sup>

One of the more revealing discussions regarding the Institute took place between the Foundation's Indian branch office and its headquarters in New York City. The exchange illustrated the ways in which international organizations tried to shape the character of India's healthcare system and, in turn, its medical technology. One of the principal actors was Alan Gregg, a Harvard- educated physician and lifelong public health leader with the RF who had spent his career developing and implementing research and public health programmes around the world.<sup>480</sup> By the time he took the post heading up the Rockefeller's Delhi office, Gregg was near the end of a long and distinguished career. He was unambiguously opposed to the All Indian Medical Institute. In a diary entry of January 28, 1952, he described a lunch with the Indian health Minister, Rajkumari Amrit Kaur, who was in the midst of helping her Congress Party

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<sup>478</sup> C. R. Unger, 'Towards global equilibrium: American Foundations and Indian Modernization, 1950s to 1970s', *Journal of Global History*, Vol. 6 (2011), p. 125.

<sup>479</sup> Letters to and from Delhi and New York, Rockefeller Family Archives, Record Group 1.2 Series 464, Box 40, Folder 305.

<sup>480</sup> US National Library of Medicine, Alan Gregg Papers. Accessed at <http://profiles.nlm.nih.gov/ps/retrieve/Narrative/FS/p-nid/212>.

campaign for elections.<sup>481</sup> Kaur, he wrote, had failed to read his report recommending that all available funds be allocated to improving medical care in pre-existing clinics and hospitals around the country. Rather, she simply declared, ‘I know you are going to help us’, implying that the Foundation would provide additional funds to the AIIMS.<sup>482</sup>

In his diary, Gregg outlined the contents of his report, which concluded that, ‘the immediate difficulties of the existing schools make further raids on your teaching strengths, such as an All India Institute, completely unwise until 1960’. In an entry later the same day, he noted that spending an extraordinarily large amount of funds for a single medical college under the control of the Central Government did not make sense whilst so many other medical schools around the country were ‘languishing’. At the end of the entry, he stated that he had made it clear to one of the Health Minister’s assistants that the financial support of the Foundation should not be assumed.<sup>483</sup> The Rockefeller Foundation made good on their promise, pouring millions of US dollars into many other Indian hospitals and medical schools, but not the AIIMS.<sup>484</sup>

The opposition of Gregg and the RF could not, however, overcome the Indian government’s determination to go ahead with the AIIMS.<sup>485</sup> The Institute’s status as a symbol of modernity proved too attractive to the Indian elite and construction of the medical centre, and the modern medical technology it would house, went ahead as planned. By April, the cornerstone of the AIIMS had been laid in a ceremony attended by leaders from across India, many of whom promised better healthcare to come.<sup>486</sup> The construction of the Institute seemed to prove that,

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<sup>481</sup> Alan Gregg diary entry, 28 January 1952, Rockefeller Family Archives, Record Group 1.2, Series 464, Box 40, Folder 305.

<sup>482</sup> *ibid.*

<sup>483</sup> *ibid.*

<sup>484</sup> ‘Rockefeller grants of over one million dollars’, *Times of India*, 17 August 1956, p. 11.

<sup>485</sup> Incidentally, the Rockefeller Foundation would spend millions in education and technologies (X-rays, labs) over the next 18 years at the All India Medical Institute, especially following Eisenhower’s visit in 1959. See Chapter 3, section 6. Letters and receipts, Rockefeller Family Archives, Record Group 1.2, Series 464, Box 40, Folder 335.

<sup>486</sup> ‘Medical Aid in India: Objectives of New Institute’, *The Hindu*, 5 April 1952, p. 4.

despite great challenges, there were signs of progress, a point underlined during the Institute's ground-breaking ceremony in April 1952, New Zealand's Minister for Industries and Commerce, J.J. Watts, noted that 'when one looks back over the last four or five years since power was handed over to Indians, and reflects upon the manifold problems of refugees, shortage of expert staff, ignorance, poverty, disease, one can draw undoubted hope and optimism from the very great achievement of these few years'.<sup>487</sup> In response to the (perceived) success of AIIMS, the Indian government continued to direct many of its scarce human resources to attracting foreign aid, either from other nations or NGOs.<sup>488</sup> Indeed, for the first few decades of the AIIM's history, all of its medical technology was imported.<sup>489</sup>

AIIMS was not the only educational facility of note developed during the 1950s. The Indian Institute of Technology (IIT), for example, was founded in 1951. Located in Kharagpur, the core mission of the institute was to provide the upper one percentile of India's high school students with a thorough education in engineering. The IIT would become the Centre of Excellence for Education and Engineering, and represented a model that was repeated in over a dozen other cities across India over the next 50 years. These emerging institutes trained many of the world's most accomplished biomedical, computer, electrical, and mechanical engineers, including a number of Silicon Valley entrepreneurs.<sup>490</sup> India's early commitment to world class education was one of the critical stepping stones for the development of biomedical engineering. It was also one of the defining moments in paving the way for India's inclusion in the international medical technology complex.

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<sup>487</sup> Medical Aid in India: Objectives of New Institute', *The Hindu*, p. 4

<sup>488</sup> Nilekani, *Imagining India: The Idea of a Renewed Nation*, p. 371.

<sup>489</sup> AIIMS receipts for many technologies paid by the Rockefeller Foundation Offices in New York for 1962-1967. 16 April 1962, Rockefeller Family Archives, Record Group 1.2, Series 464, Box 40, Folder 335.

<sup>490</sup> N. Bapat, 'How Indians Defied Gravity and Achieved Success in Silicon Valley', *Forbes*, 15 October 2012. Accessed 4 September 2014 at [www.forbes.com/sites/singularity/2012/10/15/how-indians-defied-gravity-and-achieved-success-in-silicon-valley/](http://www.forbes.com/sites/singularity/2012/10/15/how-indians-defied-gravity-and-achieved-success-in-silicon-valley/).

Table 3. INCREASE IN SCHOLARSHIPS FOR SCHEDULED CASTES AND SCHEDULED TRIBES		
Year	Total Number of Scholars Benefiting from the Scheme	Total Amount of Expenditure Incurred on the Scheme
		Rs.
1947-48	65	5,39,307
1948-49	731	4,98,303
1949-50	1414	8,56,804
1950-51	2181	12,69,456
1951-52	2834	15,40,942
1952-53	6444	30,52,267
1953-54	11934	61,55,267
1954-55	20658	107,89,000
1955-56	41451	150,53,936
1956-57	39485	187,28,382
1957-58	44962	223,11,674
1958-59	49962	223,11,675
1959-60	61962	257,37,302

Table 6: The Extraordinary Raw Growth Numbers in Scholarships for Resource Constrained Students, 1947 to 1960<sup>491</sup>

The government's commitment to education did not stop at elite centres like the IIT. Another indication of how the educational system, and medical education in particular, expanded following independence comes in a 1961 publication from the Ministry of Education's 'National Council of Educational Research and Training'. Table 6, depicted above, shows that the number of students benefitting from a new scheme of educational funding for low resource populations in India rose from 65 in 1947 to 61,962 scholars in 1960, an astonishing level of growth.<sup>492</sup> In the corresponding years, the table demonstrates how funding for the scheme grew: in 1947–8, it was funded to the amount of 539,397 rupees; by 1959–60, the same scheme was allotted 25,737,302 rupees.<sup>493</sup> This 10,000 per cent increase in education shows how India's educational institutions began to contribute to technological development; the training of technological elite was imperative for the emergence of a medical technology industry in India.

<sup>491</sup> 'National Council of Educational Research and Training, Review of Education in India: 1947–61', *Ministry of Education* (New Delhi, 1961), p. 35.

<sup>492</sup> *ibid.*

<sup>493</sup> *ibid.*

Nevertheless, in the early 1950s, Indian medical education faced the challenge of training thousands of doctors in a drastically understaffed public healthcare system. Acknowledging the situation facing India, in 1952 Rajkumari established a council charged with planning the modernization of India's medical education system. In her public statements, the health minister emphasized not just the need for primary care medical doctors, but also the maintenance and development of facilities to educate nurses and psychiatric clinicians. She went on to call for the institutionalization of village-based clinics and cottage hospitals as part of the effort to provide education and care for people across the country.<sup>494</sup> The council, as well as its media coverage, indicated the importance that the government and Indian society at large placed on primary medical care.

In keeping with this attention to healthcare education, the first five years of Indian independence saw the establishment of a number of laboratories, research sites, and other institutions essential to the development of India's industrial base. Overall, 12 laboratories were built, 328 start-ups were financed, and 207 Indian patents were filed. Furthermore, as Sir Alfred Egerton noted in his speech to the Commonwealth section of the Royal Society of the Arts in London, over a thousand research papers were published in India during its first few years of Independence.<sup>495</sup> As Pratik Chakrabarti observed in his book *Western Science in Modern India*, such efforts were part of a drive to create a foundation of medical research.<sup>496</sup> These numbers raised hope that bigger and better developments in medical technology were on the horizon.

The Indian press also encouraged interest in careers in medicine and medical technology. A youth feature article entitled 'A Career in a Test Tube' profiled the career of a woman 'eagerly

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<sup>494</sup> 'Medical Studies in India: Need to Improve Standards', *Times of India*, 21 April 1952, p. 5.

<sup>495</sup> A. Egerton, 'Scientific Research in India', p. 809; 'Further Cut in Price: Retail Sale of Antibiotics', *Times of India*, September 1959, p. 9.

<sup>496</sup> Chakrabarti, *Western Science in Modern India*, p. 291.

studying a slide under the microscope.<sup>497</sup> The author of the article, Mumtaz Motiwalla, went on to outline the young scientist's training as a medical technologist, as well as her career opportunities in India. Motiwalla concluded by noting that similar careers in pathology and microbiology were open to ambitious and smart young Indians. The attention given to medical technology by the press helped to increase the supply of labour flowing into those industries; across India, the nation's youth came to realize that medical technology was a viable, lucrative, and high-demand career.<sup>498</sup>

### **III. Traditional and Western Medicine at Loggerheads**

In addition to opening new institutions of higher learning and research, some segments of Indian society began to embrace the advanced principles of Western medicine during the 1950s. At the time of independence, many Indians, especially the wealthy, remained committed to Ayurvedic, unani-tibb, and siddha medicine, forms of treatment that had been practised in India for thousands of years.<sup>499</sup> However, not everyone in the nation had access to such forms of care. In fact, many of the traditional medical practices in India were only available to elite members of society. In *Medical Marginality*, Hardiman, Mukharji and others have shown that Indians could not afford the traditional care that existed prior to and after the spread of Western medicine.<sup>500</sup> Tensions began to emerge as the indigenous medical elite feared that they would lose their access to the upper strata of Indian society to Western clinicians. The potential for conflict was exacerbated by the fact that many of the basic principles of Ayurveda conflicted with Western

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<sup>497</sup> Motiwalla, 'A Career in a Test Tube.'

<sup>498</sup> *ibid.*

<sup>499</sup> H.E. Sheehan and S.J. Hussain, 'Unani Tibb: History, Theory, and Contemporary Practice in South Asia', *Annals of the American Academy of Political and Social Science*, 583 (2002), pp. 122–35; B.V. Subbarayappa, 'Siddha Medicine: An Overview', *The Lancet*, 350 (9094) (1997), pp. 1841–4.

<sup>500</sup> D. Hardiman and P.B. Mukharji (eds.), *Medical Marginality in South Asia: Situating Subaltern Therapeutics* (New York, 2013), p. 28.

medical technology. As Roger Jeffery's work has underlined, there had long been a tense relationship between Western and traditional medicines, as well as the political and popular influence that traditional medicine had in twentieth-century Indian policies.<sup>501</sup>

Ayurvedic medicine was more holistic than most forms of Western medicine, with many therapies based upon natural herbs and compounds.<sup>502</sup> The split between Western and traditional medicines had existed in India since the institutionalization of British medical education and practice in 1835, following the foundation of the Calcutta Medical College.<sup>503</sup> Following the suppression of Ayurvedic practices under British colonialism, the newly independent nation took great pride in bringing the traditional Ayurvedic ways back to the forefront of medical practice and research.<sup>504</sup> By April 1952, the Indian government had established the Medical Council<sup>505</sup> as the governing body for the certification of all schools of medicine and clinical practice.<sup>506</sup> On April 21, 1952, the *Times of India* reported that the Council 'opposed the idea of teaching any of the indigenous systems or medicine or homeopathy during the under-graduate course in modern medicine'.<sup>507</sup> Though well-meaning, the Council's judgment would disable aspects of the medical technology industry for the next thirty years, as fundamentalist religious groups and low-resource areas with less education fought for the use of traditional methods at the expense of medical technology.

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<sup>501</sup> R. Jeffery, 'Policies Towards Indigenous Healers in Independent India', pp. 1835-41.

<sup>502</sup> R. Svoboda, *Ayurveda: Life, Health and Longevity* (New Delhi, 1992), p. 6.

<sup>503</sup> 'Calcutta Medical College', *The Lancet*, 114 (2928) (1879), p. 558. There were attempts to resolve the differences by leaders from the two sides at several points in the early part of the twentieth century. R. Jeffery, 'Allopathic Medicine in India: A Case of Deprofessionalization?', *Social Science & Medicine*, 11 (10) (1967), p. 570.

<sup>504</sup> Hardiman and Mukharki, *Medical Marginality in South Asia*, p. 145; P. Chakrabarti, *Bacteriology in British India: Laboratory Medicine and the Tropics* (Rochester, 2012), p. 160.

<sup>505</sup> It was the pre-cursor to the formal council which was created by the second five-year plan, then called Central Health Education Bureau and the Indian Medical Council. R. Jeffery, 'Policies towards indigenous healers in independent India', *Social Science & Medicine*, 16 (21) (1982), p. 1844. Accessed at [www.mciindia.org/ActsandAmendments/TheMedicalCouncilAct1956.aspx](http://www.mciindia.org/ActsandAmendments/TheMedicalCouncilAct1956.aspx).

<sup>506</sup> Accessed 30 August 2013 at [www.mciindia.org/](http://www.mciindia.org/)

<sup>507</sup> 'Medical Studies in India', p. 5.

The religious movement's momentum throughout the 1950s, and especially its opposition to Western medicine, is evident in the speeches delivered by political leaders such as Ramakrishna Rao, the Governor of Kerala.<sup>508</sup> In a speech at the 33<sup>rd</sup> All-India Medical Conference in December 1956, delivered in front of 1,200 doctors from across the country, Rao declared, 'I cannot believe that indigenous systems which have persisted for so many thousands of years are absolutely unscientific and devoid of any merit. They have been dispassionately examined and studied with the help of modern sciences'.<sup>509</sup> He continued by declaring that members of the medical profession who practiced modern medicine should work in conjunction with indigenous systems, which ought not only to be studied, but practiced amongst the Indian populous. Rao's defence of traditional methods was an attack on medical technology in the sense that utilizing Ayurveda and indigenous medicines necessarily precluded the use of modern medicines. There was also an increase in the production and industrialization of Ayurvedic medicines around India as demand increased.<sup>510</sup> The material consequence of such rhetoric was a reduction in demand for Western-style devices, supplies, and medicines.

Health Minister Rajkumari had initially opposed the use of Ayurvedic methods in medical treatment. As a result of campaigning from many of India's Ayurvedic supporters, however she quickly changed her mind about excluding indigenous medicine from the educational system.<sup>511</sup> During the inaugural address at the Jhansi Ayurveda University Convocation, Rajkumari declared that Indian medicine had played a role in both indigenous

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<sup>508</sup> 'Modern and Indigenous Medicines: Dr. Rao Advocates "Co-existence"', *Times of India*, 27 December 1956, p. 11.

<sup>509</sup> *ibid.*

<sup>510</sup> M. Nichter and N. Vuckovic, 'Agenda for an Anthropology of Pharmaceutical Practice', *Social Science & Medicine*, 39 (11) (1994), p. 1519.

<sup>511</sup> 'Modern Medicine and Ayurveda: Minister calls for Synthesis', *Times of India*, 23 December 1956, p. 9.

medicine and the ways in which Western countries viewed and practiced medicine as well. She stated that,

The aim of medical science today in all countries is the same, namely, to ensure that the people should live in a state of positive health. In achieving this end in our country, we shall not only be helped by all that is available to us in modern medicine, but also by all that is best in our own indigenous system of medicine.<sup>512</sup>

Rajkumari was clearly moving away from a ‘Western medicine only’ mantra to a combination of Western, Unani, and Ayurvedic medicine. Her apparent *volte-face* was most likely brought about by political pressure exerted by the religious Hindu leadership, which vehemently opposed many Western practices. The conflict between Western and indigenous medicine in India has been studied rigorously in the historical scholarship.<sup>513</sup> Throughout the literature, there are numerous examples of the Indian society’s rejection of, or hesitation to accept, Western medicine. Indeed, the split between native medical practices and Western vaccination procedures produced resistance to inoculation, including riots.<sup>514</sup> The traditional suppliers and producers of indigenous medicines and processes began to see their authority replaced or demeaned.<sup>515</sup> The loss of authority amongst the established Ayurvedic base was an important consideration for Rajkumari in this period of India’s medical history.<sup>516</sup> The cultural ambiguity regarding Western medicine and technology was a clear barrier to the diffusion of medical technology innovations in India in 1952–63.

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<sup>512</sup> *ibid.*

<sup>513</sup> C.M. Leslie and A. Young (eds.), *Paths to Asian Medical Knowledge* (No. 32) (Berkeley, 1992), p. 182; Bhattacharya, *Fractured States*, p. 236.

<sup>514</sup> Bhattacharya, *Fractured States*, p. 236.

<sup>515</sup> R. Chandavarkar, *The Origins of Industrial Capitalism in India: Business Strategies and the Working Classes in Bombay, 1900–1940* (Vol. 51) (Cambridge, 2003), p. 254.

<sup>516</sup> *ibid.*

#### IV. International Exposure: Networks Help New Technologies

A central aspect of the development of India's medical technology industry was the ability to implement and execute high level research and development for life sciences, medical supplies, and medical devices. The infrastructure to achieve this existed in India long before independence. With the advent of Crown rule from the 1850s, institutions of medical research, though small relative to India's overall population, were implemented and developed in the subcontinent.<sup>517</sup> Whether it was to maintain the health of workers exploiting sugarcane in the West Indies, or miners in Africa, the need to diagnose, treat, and manage tropical disease became fundamental to the imperial landscape.<sup>518</sup> The role that Britain's colonial administration played in the development of medical technology in imperial India has already been highlighted in Chapter 2, and it continued to play a role across the latter half of the twentieth century.<sup>519</sup>

Throughout British rule, India was a test site for new medicines and devices. Even after the end of colonialism, the institutions and research methods pioneered by the British remained intact.<sup>520</sup> And, as seen in Chapter 2, although institutions such as the Roorkee Engineering College and the Tata Institute for Fundamental Research were relatively few and far between, they were significant in terms of innovation. They were integrated into a network of organizations alongside other research institutes in Commonwealth nations. This created a small but thriving network of medical technology research centres within the Indian medical research community.<sup>521</sup> The country's scientific community maintained and expanded its relationships

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<sup>517</sup> Chakrabarti, *Western Science in Modern India*, p. 291; M. Harrison, *Public Health in British India: Anglo-Indian Preventive Medicine, 1859–1914* (Cambridge, 1994), p. 60.

<sup>518</sup> D.L. Keir, 'Western Medicine in the Modern World', *The Lancet*, 267 (6843) (1954), p. 823, D.M. Haynes, *Imperial Medicine: Patrick Manson and the Conquest of Tropical Disease* (Philadelphia, 2001), p. 10; M. Worboys, 'The Colonial World as Mission and Mandate: Leprosy and Empire, 1900–1940', *Osiris*, Vol. 15 (2000) p. 217.

<sup>519</sup> Chakrabarti, *Western Science in Modern India*, p. 290.

<sup>520</sup> 'Report on the Public Health Programs of India', Government of India Health Ministry, Undated, NAI.

<sup>521</sup> J.B. Meyer and M. Brown, 'Scientific Diasporas: A New Approach to the Brain Drain', *Management of Social Transformations (MOST) Programme* (1999). Accessed at [www.unesco.org/most/meyer.htm](http://www.unesco.org/most/meyer.htm).

with the network of British Commonwealth universities and institutes around the world.<sup>522</sup> Whilst aid from the Commonwealth primarily focused on financial, military, transportation, and manufacturing sectors, medical technology also benefited.

The newfound interest in India from overseas continued throughout the 1960s, as a February 1960 article on alternative medicine in the *New York Times* makes clear. The article detailed the numerous expeditions being carried out by life science organizations across the subcontinent to discover and harvest new medicines.<sup>523</sup> These resources were a pivotal site of investment and growth by native and foreign sources of investment capital. It was one of many variables that contributed to the growth of India's leadership in the global medical environment.

One early investor was the US pharmaceutical giant Merck. In April 1959, the *Wall Street Journal* featured an article arguing that overseas markets had become a new area of focus in the drug field, focusing in particular on the origins of Merck's operations in India.<sup>524</sup> Merck had come to India in 1958 through a joint venture with Tata Sons; the goal had been to establish an Indian company with a capitalization of about \$8.4 million USD.<sup>525</sup> From Merck's perspective, entry into the Indian market would provide 400 million new customers; from the Indian point of view, the partnership would provide the nation with badly needed pharmaceuticals.<sup>526</sup> Moreover, due to cheaper production costs in the subcontinent and the favourable currency exchange rate, medication would come at a substantial discount. At the time of its inception, the new company was expected to become the largest drug manufacturer in India.<sup>527</sup> India's ability to incorporate private enterprise into the growth of its medical technology

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<sup>522</sup> 'India Must Hasten Technological Revolution – Indira', *Times of India*, 8 September 1967, p. 9.

<sup>523</sup> B. Bart, 'Boom is Sparked by Exotic Plants', *New York Times*, 28 February 1960, p. 1.

<sup>524</sup> 'Wall St. Focuses on the Drug Field', *New York Times*, 3 April 1960, p. 9.

<sup>525</sup> 'Merck & Co. and Tata of India to Form Drug Manufacturing Concern at Bombay', *Times of India*, 4 November 1958, p. 36.

<sup>526</sup> *ibid.*

<sup>527</sup> *ibid.*

industry was a key component of its strategy toward the end of the second five-year plan, which focused on the development of heavy industry.<sup>528</sup> Merck's deal with the Tata Company provided further proof that the medical technology industry could thrive in India.

The deal between Merck and Tata did not take place in a vacuum. There had been several earlier partnerships between Indian and foreign companies in the 1950s, including one between J.R. Geigy, a pharmaceutical concern based in Switzerland, and Vikram Sarabhai, the CEO of Sarabhai Chemicals.<sup>529</sup> Sarabhai had been a pioneer in chemicals and pharmaceuticals in India in the mid-twentieth century; following the growth of the government's investments in healthcare and medicine, he began to pivot his chemicals business into pharmaceuticals. His joint venture with Geigy was followed by a venture with Merck, albeit on a smaller scale than the one Merck had with Tata. In this venture, Sarabhai Chemicals and the German company E. Merck (not to be confused with the American company) joined up for large-scale production of Vitamin C.<sup>530</sup> These ventures provided even more fuel to the growing medical technology fire experienced by India in the 1950s.

## **V. The Flaw of Technology: Replacement Parts From Afar**

As noted above, the Rockefeller Foundation had a particular interest in India, identifying it as a country in particular need of improved medical education, technology, and delivery. The initial goal of the RF was to distribute funds to numerous hospitals around the country to improve clinical education and care. As the West increasingly focused on India as a key battle ground with the Soviet Union, there was an increased allotment of funds from the RF to India. Over the

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<sup>528</sup> R. Mohan and A. Vandana, 'Commands and Controls: Planning for Indian Industrial Development, 1951–1990', *Journal of Comparative Economics*, 14.4 (1990), pp. 681–712.

<sup>529</sup> A. Shah, *Vikram Sarabhai: A Life* (New Delhi, 2007), p. 103.

<sup>530</sup> *ibid.*

entirety of the 1950s, the RF and many other Western-based foundations donated millions of dollars with the goal of spreading Western medicine throughout India.<sup>531</sup> In a report dated 1 April 1959, the RF indicated that its planned expenditures in India would be roughly \$9 million USD in donations to the AIIMS.<sup>532</sup>

This section examines a series of communiqués from AIIMS that show that the institute obtained parts for their medical devices such as X-ray machines and other radiological devices from predominantly non-Indian sources. These communiqués show the processes and administration that the nation's leading hospital needed to follow in order to maintain a critical piece of medical diagnostic equipment: an X-ray machine. This exchange of letters over the course of months uncovered the painful process of medical device issues and the protocols needed in order to obtain a single part, without which, the entire device is crippled and made inoperable.

The central government aimed to provide AIIMS with the same medical technology that could be found in hospitals in London and New York.<sup>533</sup> Along those lines, it was the government's wish that nations and foundations alike fund AIIMS' technological aspirations whenever possible. A March 5, 1962 letter from Lucien Gregg, the associate director of the New Delhi offices of the RF, confirmed that the foundation was trying to help AIIMS gain access to state of the art medical technology equipment.<sup>534</sup> Gregg wrote to the RF headquarters in New York asking for assistance in the purchase of modern X-ray equipment. He asked whether 'AIIMS can hope to get an additional RF grant of \$300,000 USD to be available during the next

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<sup>531</sup> S. Hewa and D. Stapleton, eds., *Globalization, Philanthropy, and Civil Society: Toward a New Political Culture in the Twenty-First Century* (New York, 2005), p. 55.

<sup>532</sup> B. Ward, 'India in the Strategy of Western Aid', *Guardian*, 15 August 1961, p. 10.

<sup>533</sup> The All India Institute of Medical Sciences Act, 1956. Accessed at [www.aiims.edu/aiims/ritact/AIIMS-ACT-RULES.pdf](http://www.aiims.edu/aiims/ritact/AIIMS-ACT-RULES.pdf).

<sup>534</sup> L.A. Gregg, M.D., Letter to Dr. B.B. Dikshit, 5 March 1962, Folder 335, Box 40, Rockefeller Archive Center, Butler Library, Columbia University, p. 1.

three years for the general purposes stated on the attached sheet.’ Even if \$300,000 USD was not possible, he continued, partial funding would be helpful in providing the X-ray department with proper equipment.<sup>535</sup>

The need for modern medical technology did not stop at X-ray equipment. In the same letter, Gregg requested an electron microscope on behalf of R.K. Mishra, a biophysicist at AIIMS. Mishra had asked for the microscope to conduct advanced work in the areas of pathology, microbiology, and microanatomy. The research he hoped to conduct would not only assist with patient care and advanced diagnostics, but also improve AIIMS’ ability to develop new vaccines and new medicines. The communication between Gregg and AIIMS shows the ongoing effort of Western foundations to establish positive relations with India.

Foreign policy continued to play an influential role in the development of medical technology in India. Attached in the same letter from Gregg to the RF headquarters in New York City was a letter to B.B. Dikshit, a purchasing officer for AIIMS, concerning the allocation of funds for X-ray equipment at the AIIMS. In this letter, Gregg referred to a conversation with Health Minister Rajkumari:

As you know, a number of European countries have well established manufacturers of radio-diagnostic and radio-therapeutic equipment. I am wondering whether Rajkumari may wish to explore with representatives of one or more of those countries the possibility of a donation of X-ray equipment from them to the institute.<sup>536</sup>

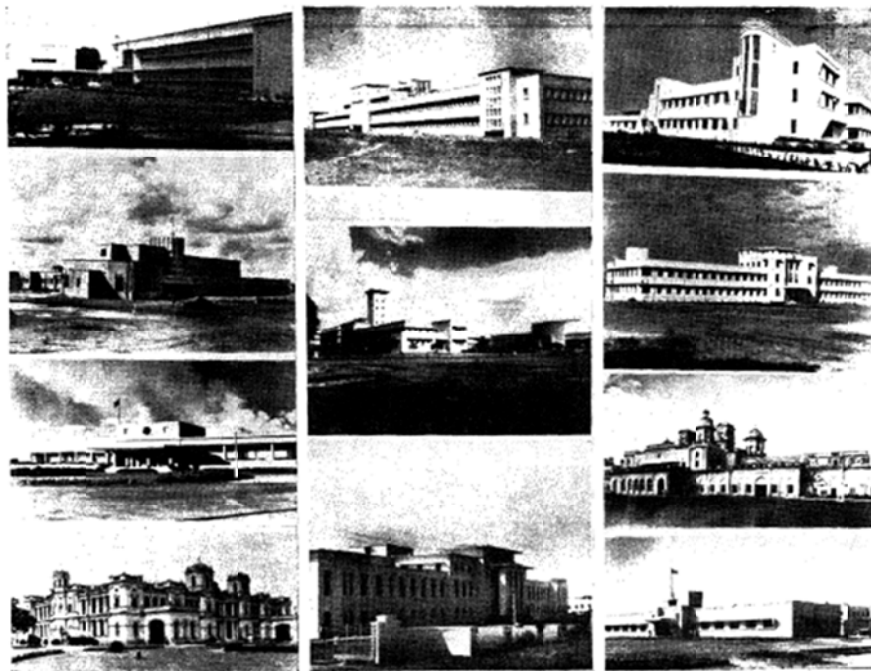
Such conversations show how closely the foundations worked with medical manufacturers on the industrial side of medical technology; the fact that Gregg suggested that the director of the

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<sup>535</sup> *ibid.*

<sup>536</sup> *ibid.*

AIIMS seek donations from multi-billion dollar medical manufacturers indicates that this kind of practice was well established.



*Figure 4: A sampling of pockets of medical technology production facilities in India in 1955, many of which were built with aid from the West.<sup>537</sup>*

## **VI. The Influence of Cold War Politics on Development in India**

The development of medical technology in India was not immune from international politics; the Cold War was very much a part of India's reality. As the success of the Marshall Plan, America's response to the potential spread of communism in post-World War II Europe, was celebrated across the West as a major factor in economic development and political stabilization, the Soviet

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<sup>537</sup> Egerton, 'Scientific Research in India', p. 809.

Union looked elsewhere to increase its influence in geopolitical matters.<sup>538</sup> India was considered vital to the West's approach to Asian foreign policy due to its close proximity to China and the spread of communism in that part of the world. This section will focus on how India's non-alignment foreign policy placed it in an advantageous position.<sup>539</sup>

As the world's most populous free country, India was seen as a prize for the Soviets, a fact the West quickly recognized. A 1949 memorandum reporting a conversation between India's Ambassador to the US, Sir Benegal Rama Rau, and Secretary of State Dean Acheson, indicated that India was seen as a key element in the stabilization of Southern Asian.<sup>540</sup> During their conversation, Rama Rau indicated that he 'was afraid that the success of the Marshall Plan in Western Europe would mean that Communism would turn on the Far East and particularly India, with renewed vigour.' The ambassador continued that India's 'new universal suffrage' had to be taken into consideration, given that vast numbers of the poor voted for communist parties. Moreover, unless 'substantial economic progress could be made by the democratic government currently in office, there was a definite possibility that the large majority of India's population, which is grossly under-fed and under-clothed would tend to carry elections far to the left.'<sup>541</sup>

Further validation of the importance of India's position in the global political landscape came on the fourteenth anniversary of its independence, when the *Guardian* wrote about India's place in the overall strategy of Western aid during the Cold War:

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<sup>538</sup> D. Stone, ed., *The Oxford Handbook of Postwar European History*, (Oxford, 2012), p. 370. Originally known as the European Recovery Plan (ERP), the Marshall plan was implemented from 1948 to 1951. Through a series of versatile economic interventions, ranging from currency support to technology transfer, various US government and multilateral agencies were able to improve the economic stability in Western Europe. *ibid.*

<sup>539</sup> In 1948, India joined the newly-formed World Health Organization, and its role as one of the most populated countries in the world was not taken lightly. Park, *Textbook of Preventive and Social Medicine*, p. 641.

<sup>540</sup> *Farewell Call of the Indian Ambassador, Sir Benegal Rama Rau*, US Department of States Memorandum of Conversation (1949), Independence, MO: Harry S. Truman Library & Museum Acheson Memoranda of Conversation.

<sup>541</sup> *ibid.*

In this new context the position of India is central. It contains nearly half the population of the uncommitted, developing world. Solve Indian difficulties and almost half the problem of development is under control. India has also shown, both in its relations with the West and in its internal policies, the clearest working model so far available for the new strategy.<sup>542</sup>

The *Guardian*'s article gave expression to the Western view that this fledgling democracy needed to be stabilized, preserved, and nurtured. Such a view was echoed by the *New York Times*, which explained that,

Three factors have figured prominently: (1) India's unwavering policy of non-alignment with power blocs, which has enticed both sides to court her; (2) Her determination to develop her economy, as seen in her ambitious Five Year Plans; (3) The existence of an organized, though sometimes unwieldy, administrative system to implement development plans.<sup>543</sup>

These three points laid out how India had progressed from a colonial supplier to a world power broker, whilst still securing vast resources from foreign governments, corporations, foundations, and multi-lateral agencies.

The political leadership in India was acutely aware that it could benefit economically, politically, and medically by fostering and maintaining strong relationships with both sides of the Cold War divide. As Prime Minister Nehru put it,

It is said there are only two ways of action in the world today, and that one must take this way or that, I repudiate that attitude of mind. If we accept that there are only two ways, then we certainly have to join the Cold War – and if not an actual military bloc, at least a mental military bloc.<sup>544</sup>

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<sup>542</sup> B. Ward, 'India in the Strategy of Western Aid', p. 10.

<sup>543</sup> W. Grimes, 'Foreign Aid: Indian Case History: Soviets Have Scored But U. Gains', *New York Times*, 21 February 1960, E5.

<sup>544</sup> H. Muppidi, 'Postcoloniality and the Production of International Insecurity: The Persistent Puzzle of US-Indian Relations', *Cultures of Insecurity: States, Communities, and the Production of Danger* (Minneapolis, 1999), p. 127.

India often increased relations with one to leverage more resources from another. India's foreign policy manoeuvring can be seen in August 1956, when a delegation from India toured Russia to examine Soviet methods of pharmaceutical production.<sup>545</sup> A report in the *Times of India* explained that the delegation, which consisted of corporate, government, and academic leaders, would spend four weeks in the Soviet Union, before heading to West Germany, Switzerland, and Italy to study techniques that would help to develop their domestic drug industry.<sup>546</sup> In addition, the article noted that the Soviet Union had already proposed the expansion of existing manufacturing plants and the building of new facilities for the manufacture of a number of different medicines, including antibiotics and analgesics. The Soviet experts recommended using indigenous raw materials in order to improve the volume of manufacturing for the plants.<sup>547</sup>

India's attempts to play both sides of the Cold War divide was helped by the emergence of a new paradigm known as the domino principle, which stipulated that as one group or nation fell under the sway of communism, neighbouring countries would likewise succumb. The domino principle was explicitly invoked by the RF directors in India in support of the need to maintain a free and democratic India and contributed to long term investment by the U.S. and other Western nations.<sup>548</sup>

In 1966, for example, President Johnson expressed his fear that the U.S. was in danger of losing Asia and eventually Europe, famously noting to his biographer, Doris Kearns, 'and when that comes to pass ... I'd hate to depend on the Galbraiths and that Harvard crowd to protect my property or lead me to shelter in the Burnet caves.'<sup>549</sup> Thus, the domino principle led to

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<sup>545</sup> R. Parker, 'Soviet Aid for Pharmaceutical Plant Project: Indian Team Signs Pact in Moscow, 80 Million Ruble Credit Offered', *Times of India*, 30 May 1959, p. 1.

<sup>546</sup> *ibid.*

<sup>547</sup> *ibid.*

<sup>548</sup> Hardiman, *Healing Bodies*, p. 9.

<sup>549</sup> S.J. Whitfield, *The Culture of the Cold War* (Baltimore, 1991), p. 227.

significant expenditure of military resources and technologies as well as significant levels of cooperation and investment in the arena of medical technology and public health. This combination of altruism and *realpolitik* by democratic states led to a convergence that substantially accelerated the development of the medical technology in India during the 1950s.

As part of the West's on-going effort to prevent India from moving into the communist bloc, cheap medical technologies from what were then emerging market countries such as Japan were imported to India. The Western nations saw Japan as the perfect production site for new medical technologies: Japanese quality was high but prices were low, particularly compared to larger European medical device manufacturers like Siemens and Phillips.<sup>550</sup> Japan had quickly recovered from World War II and was looking to find new markets to sell its high-end medicines and medical devices. To aid these efforts, Fusazo Inaba, of the Osaka Medical Trade Mission, travelled to Bombay in February 1954 to help India to develop its pharmaceutical industry.<sup>551</sup> Inaba stated that Japan's relationship with India was a symbiotic one, with Japan importing huge quantities of Indian cotton, iron, and other alloys. The purpose of Inaba's visit to India was to increase medical technology exports from Japan to India so that the trade relationship would become more balanced. To that end, the Japanese Trade Mission used Indian newspapers to publicize the fact that the average lifespan in Japan had increased to 60 years of age, compared to the pre-WWII figure of 50 years. The increase, they claimed, was primarily due to the availability of better medicines at a lower cost.<sup>552</sup>

The fact that a 'Western' producer of medicines, supplies, and devices went to such efforts to make major technologies and pharmaceuticals available to such a resource-constrained nation shows the West's interest in maintaining its influence in India. Given that Japan imported

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<sup>550</sup> L.A. Gregg, M.D., letter to Dr. B.B. Dikshit, 5 March 1962, p. 1.

<sup>551</sup> 'Medicines and Drugs Import: Jap Mission's Offer', *Times of India*, 11 February 1954, p. 4.

<sup>552</sup> *ibid.*

vast amounts of raw materials such as cotton and iron from India, it was clear that one goal of Inaba's trade mission was to highlight Japan's medical technologies as one of the benefits of a free-market, democratic society. Such policies were clearly aligned with the mission of Western governments, foundations, and multi-lateral organizations and underlined the fact that if India were to turn communist, those policies would likely be curtailed.<sup>553</sup>

The work of a Japanese corporation, American Foundation, and other agencies illustrate the joint and far-reaching efforts that various healthcare institutions from the 'West' undertook in order to improve India's public health system. The Indian government responded favourably to such overtures, which in turn encouraged these entities to provide more medical technology resources. The complex of organizations required for medical technology development, distribution, and implementation had created a powerful new force in international development and politics.

During the period under review, new leaders on both sides of the Cold War divide emerged. Dwight D. Eisenhower became president of the United States in January 1953, whilst Nikita Khrushchev became the Soviet leader two months later. Both leaders visited India, which, as noted above, was keen to preserve its independence. In June 1955, Nehru visited the Soviet Union with his daughter Indira Gandhi.<sup>554</sup> Khrushchev's goal was to show Nehru the accomplishments of socialism. Later that year, Khrushchev toured India, visiting New Delhi, Calcutta, Bombay, and Madras.<sup>555</sup> The visit was regarded as a success and heralded the start of a strong Indian-Soviet relationship.<sup>556</sup>

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<sup>553</sup> *ibid.*

<sup>554</sup> S. Khrushchev (ed.), *Memoirs of Nikita Khrushchev*, Vol. 3 (University Park, 2007), p. 726.

<sup>555</sup> Khrushchev (ed.), *Memoirs of Nikita Khrushchev*, p. 729.

<sup>556</sup> *ibid.*, p. 744.

In December 1959, meanwhile, Eisenhower visited India as part of an eleven-nation visit to Italy, Turkey, Pakistan, Afghanistan, India, Iran, Greece, Indonesia, France, Spain, and Morocco.<sup>557</sup> In what the popular press dubbed his ‘three-continent tour,’ Eisenhower spent four-and-a-half days of his eighteen-day tour in India alone.<sup>558</sup> The tour began in New Delhi, with Eisenhower delivering a speech that invoked his farm boy roots as a way to explain his passion for launching a ‘world-wide war on hunger.’<sup>559</sup>

Eisenhower’s visit was seen as the beginning of a new relationship between India and the United States, as America looked to counterbalance the progress that the Soviet Union had made over the decade. On the eve of Eisenhower’s visit to India, America provided agricultural loans in excess of \$200 million USD. The RF, meanwhile, approved a funding allotment of \$500,000 USD for the creation of AIIMS.<sup>560</sup> The board of trustees appropriated the funds to be available until the end of December 1965 and approved an additional \$500,000 USD to be released at the discretion of an executive committee over the same period of time for additional discretionary spending. On top of the Rockefeller funds, the Ford Foundation provided \$30 million USD, primarily in the areas of rural development and educational advancement. In addition, private American aid provided scholarships and technical assistance for the development of India’s economy to the mark of \$55 million USD.<sup>561</sup> The alignment between the U.S. political leadership and one of the world’s leading foundations to bolster India’s healthcare indicated the importance of the medical technology complex to the geopolitics of the Cold War.

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<sup>557</sup> D.D. Eisenhower Daily Appointment Schedule, 1 December 1959 to 31 December 1959, *Presidential Papers: Dwight D. Eisenhower Diary Series* (Dwight D. Eisenhower Library: Abilene, Kansas). Accessed 5 September 2013 at [http://web2.millercenter.org/dde/documents/presidential\\_papers/dde\\_diary\\_series/1959/dde\\_1959\\_12.pdf](http://web2.millercenter.org/dde/documents/presidential_papers/dde_diary_series/1959/dde_1959_12.pdf).

<sup>558</sup> *ibid.*

<sup>559</sup> Premier Nehru, ‘Speeches Made by Eisenhower and Nehru in New Delhi’, *New York Times*, 12 December 1959, p. 10.

<sup>560</sup> ‘Increasing American Aid to our Country’, *Times of India*, 9 December 1959, p. 18.

<sup>561</sup> *ibid.*

India's non-alignment policy gave it the ability to secure vast resources from both communist and free-market nations. The international pressure to provide free-market leaning nations with the financial aid to maintain their government was immense. One of the key points to consider with regard to mid-twentieth-century India was therefore the stability of its open economy. As it emerged from independence as a democratic free-market society, India contended with a number of points of instability. The Cold War mentality was one in which the stability of a country often depended upon the ability to maintain a fundamental order of society, including access to the basic materials of agriculture and industrial production. That order was at the heart of the continued support by the west of India's economic status quo. The fact that the Indian government was able to maintain its deft policy throughout the mid-twentieth century was central to the development of its medical technology industry.

1954-87		KHRUSHCHEV, 1954-64		BREZHNEV, 1965-82		GORBACHEV, 1985-87	
Recipient	%	Recipient	%	Recipient	%	Recipient	%
India	19	Egypt	26	Turkey	11	India	51
Afghanistan	10	India	21	India	11	Nicaragua	14
Turkey	8	Afghanistan	14	Morocco	10	Afghanistan	12
Iraq	7	Algeria	6	Afghanistan	10	South Yemen	5
Morocco	5	Iraq	5	Nigeria	6	Algeria	4
Algeria	5	Syria	3	Iran	5	Brazil	4
Syria	5	Ethiopia	3	Pakistan	4	Egypt	3
Egypt	4			Algeria	4		
Nicaragua	4			Syria	3		
Ethiopia	4			Ethiopia	3		
Pakistan	3						
Nigeria	3						
Iran	3						
Total:	80		78		67		93

Source: Peter Zwick, *Soviet Foreign Relations: Process and Policy* (Englewood Cliffs, NJ: Prentice-Hall, Inc, 1990): 295, Table 9-1.

\* This table denotes countries that received at least three percent of the total Soviet economic aid during the given period.

Table 11: Soviet Economic Aid to Non-communist Less-developed Countries, 1954 to 1987 and by Regimes (million

\$US)<sup>562</sup>

## VII. Conclusion: A New Public Health Policy Emerges With a New Nation

Indian medical technology evolved as a result of efforts to build influence by foreign governments, works of good will by various foundations, and revenue and profit seeking by private enterprise. The continued involvement of the international medical technology complex will be explored in Chapter 5. Much of what developed in the field of medical technology in India between 1952–63 occurred as a result of actors beyond India's borders, as indicated in New Zealand's gift of a \$1 million USD grant for the foundation of AIIMS, the RF's \$9 million USD

<sup>562</sup> Conley, 'Indo-Russian Military and Nuclear Cooperation: Implications for US Security Interests', p. 18.

to fund medical technology equipment, and various Western corporations' pharmaceutical ventures.

The debates surrounding the compatibility of traditional Ayurvedic healing methods with Western medicine highlighted the socio-cultural issues facing India as the government struggled to bring basic forms of public healthcare to India's growing population. Health Minister Rajkumari faced fierce resistance from indigenous medical practitioners and, as we have seen, substantively altered healthcare policies in India. The diffusion of medical technology from Western countries was clearly hampered by Ayurvedic leaders' insistence on the continued relevance of traditional healing.

Furthermore, the impact of industrialization and modern technology was very different in 'Western' and 'Eastern' countries, as Wolfram Fischer noted in his 1966 essay 'Social Tensions at Early Stages of Industrialization.'<sup>563</sup> His analysis included Japan, Turkey, Korea, the U.S., Britain, France, Germany, and India, as well as parts of Latin America. Drawing on his research, Fischer argued that whilst there were pockets of industrialization taking place in Indian cities such as Bombay and Calcutta, such industrial progress rarely affected the life of citizens in rural areas of the subcontinent. He went on to argue that industrialization in other early development Asian, African, and Latin American countries had different results and that many of those inherent cultures became resistant to Western practices of industrializations as they grew.<sup>564</sup> The social tension added to the already growing diffusion barrier needed to be broken for the public to create demand for domestic medical device production in India. This was seen not only in the 1950s but also in subsequent decades, as India attempted to deploy technological resources

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<sup>563</sup> W. Fischer, 'Social Tensions at Early Stages of Industrialization', *Comparative Studies in Society and History* (1966), p. 79.

<sup>564</sup> *ibid.*

against polio, smallpox, and tuberculosis. As we will see in Chapter 6, India would become one of the last nations to eradicate smallpox in 1975.<sup>565</sup>

This chapter has demonstrated that the roots of the production and implementation of India's medical technology industry resulted from a significant element of guile in international relations. Cold War politics had a major impact on the development of medical technology in India in the 1950s and early '60s. The activities of both the Soviet Bloc and Western nations, particularly around the time of President Eisenhower's visit to India, clearly mapped onto geopolitical agendas and paved the way for substantial funding. India's foreign policy of non-alignment allowed it to forge strong relations with both sides, resulting in vast resources being invested into India's medical technology industrial base.

Both communist and capitalist nations helped fund the purchase of early medical technology for India, as well as the means to manufacture it. Such funding helped to transform India from an export-heavy, commodity-driven, colonial supplier into a self-sustaining vaccination producer. Parallel efforts by private corporations, governments, and non-governmental organizations eventually led to India gaining superiority in fields such as agriculture, transportation, and military power, as well as medical technology. The government was able to wield its sizeable population-based market power, strategic geopolitical location, and natural resources to deliver tangible financial and health benefits to all aspects of Indian society. The loans and gifts that resulted from non-alignment greatly contributed to the solidification of India's base in medical technology; as we will see in subsequent chapters, these would eventually lead to India becoming a medical technology world power.

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<sup>565</sup> L.K. Altman, 'India Declared Free of Smallpox; Two Countries Left', *New York Times*, 3 July 1975, p. 29.

## Chapter 5: Medical Technology – 1964 to 1972

‘A nation’s strength ultimately consists in what it can do on its own, and not in what it can borrow from others.’<sup>566</sup>  
– Indira Gandhi

As India’s medical technology industry began to build a strong foundation across corporate, multilateral, medical mission, and governmental funding, the political landscape was undergoing massive upheaval, with extraordinary levels of inflation and unemployment. India’s economic woes were sapping confidence, as a contemporary article made clear: ‘The euphoria of independence, now in its twentieth year, has evaporated. There has been four bad years, with two wars, the death of two Prime Ministers, a devaluation, and drought two years running.’<sup>567</sup> India was facing a myriad of challenges and growing pains as it moved from an agrarian colonial supplier to an urbanized regional power.

One of the primary challenges facing the nation was its on-going ‘political flux’.<sup>568</sup> Throughout the latter half of the 1960s, many capitalist countries saw the rise of socialist or leftist governments, including Japan. India followed a similar path: in the face of growing economic and developmental struggles, public discontent in India increased and Congress’s overall power declined significantly in the second half of the 1960s.<sup>569</sup> The most visible outcome was the people’s support shifting from the Congress Party to India’s Communist Party.<sup>570</sup> India, one academic declared, needed to ‘reassess its bureaucratic quagmire and [begin] a fresh

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<sup>566</sup> S. Thelikorala, ‘Indira Gandhi: Iron Lady of India’, *Asian Tribune*, 19 November 2011. Accessed at [www.asiantribune.com/news/2011/11/18/indira-gandhi-iron-lady-india](http://www.asiantribune.com/news/2011/11/18/indira-gandhi-iron-lady-india).

<sup>567</sup> T. Hartford, ‘India’s Crisis of Confidence’, *Guardian*, 6 December 1966, p. 8.

<sup>568</sup> J. Amuzegar, ‘Economic Systems in Search of Nations’, *Social Research*, 35 (1) (1968), p. 202.

<sup>569</sup> A. Kohli, (ed.), *The Success of India’s Democracy* (Cambridge, 2001), p. 8.

<sup>570</sup> *ibid.*

economic self-examination.<sup>571</sup> Prime Minister Indira Gandhi, in other words, needed to take urgent action to save the party, as well as her own political future. The result was an unprecedented political pivot, in which Gandhi remade the Congress Party in the early 1970s under much more socialist and progressive principles. The new Congress's Party main goal was the 'alleviation of poverty.'<sup>572</sup>

Even in this difficult environment, however, the medical technology community continued to thrive. To take one example, as the 1960s progressed, the pharmaceutical sector grew. In an article dated April 20, 1964, the *Times of India* highlighted the growth of medical technology in the country.<sup>573</sup> Entitled 'Promising Trend in Drugs and Chemicals,' the article stated that the demand for penicillin had been roughly 10 million units in 1954, which had risen to 50 million units a decade later. Even this output, however, met only 65 per cent of what was required by the nation's healthcare system. The article traced the dramatic rise in usage to the increase in government hospitals and public health centres, which had expanded substantially over roughly twenty years of independence. It also noted that the price of the common antibiotic streptomycin was substantially less than prices in other major countries: 'A vial of penicillin that sells for 35 nR. in India costs about 150 nR. in the United States and about 100 nR. in the United Kingdom.'<sup>574</sup> As prices dropped, demand increased, doubling every five years.

This chapter will examine India from 1964 to 1972. Firstly, a general overview of the period will take place. Secondly, the chapter will discuss the increased emphasis on education. Following this, we will examine the Patents Act of 1970, one of the most revolutionary policies of twentieth century technology, and consider the foreign relations implications of India's

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<sup>571</sup> Amuzegar, 'Economic Systems in Search of Nations', p. 213.

<sup>572</sup> Kohli, *The Success of India's Democracy*, p. 8.

<sup>573</sup> 'Promising Trend in Drugs and Chemicals', *Times of India*, 20 April 1961, p. 1.

<sup>574</sup> *ibid.* nR. was the abbreviation for an Indian Rupee, now abbreviated INR. *ibid.*

departure from international law. This chapter will demonstrate that the single most significant event marking India's ascendancy as a medical superpower did not take place in a university lab, manufacturing plant, or battlefield, but rather in a house of elected representatives. Then, the chapter analyses how the Patents Act was received by various MTC stakeholders around the world, as well as the toll it took on India's short-term prospects within the international community. The chapter concludes by outlining additional improvements in medical technology, such as vaccines and clinical trials.

### **I. India during the Period 1964–1972**

In the period under review, India's economy was in a fragile state, with the average GDP growth rate plummeting.<sup>575</sup> The nation's financial situation was exacerbated by drought, as well as war with China in 1962 and Pakistan in 1965.<sup>576</sup> Poverty and destitution remained a stark reality for most people.<sup>577</sup> In an October 1967 letter to the headquarters of the SPG in London, Leslie H. Drage, a chaplain in Bombay, described how desperate India's condition remained: 'The first impression one has on arriving in India is of people, people everywhere. The second, in Bombay, is the utter poverty, such as I have not met before in S.E. Asia or in Africa.'<sup>578</sup> These sentences underline the dire situation in much of India in the late 1960s, even relative to the rest of the developing world. It was clear that, as much progress as India had made in the first twenty years of independence, the need for radical social and economic change still existed. Described as 'run down', the chaplain stated that the economy in rural areas consisted primarily of subsistence

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<sup>575</sup> A. Panagariya, *India: The Emerging Giant* (New Delhi, 2008), p. 47.

<sup>576</sup> B. Chandra, *India Since Independence*, (New Delhi, 2008), p. 456.

<sup>577</sup> G. Datt and M. Ravallion, 'Why Have Some Indian States Done Better Than Others at Reducing Rural Poverty?' *Economica*, 65 (257) (1998), p.18.

<sup>578</sup> L. H. Drage, Letter to D. Wright. 13 October 1967. Special Collections & Western MSS (M467). Bodleian Library of Commonwealth and African Studies, Rhodes House, Oxford University Library Services, Oxford, UK.

farming for the farmer and his family, which rarely left enough for sales in other villages or states. This added to a sense of ‘fragmentation’ across the country, leading to growing discontent. Drage also noted that militant Hinduism was ripe across much of India, noting that ‘each Indian should be a Hindu and if not should leave the country.’<sup>579</sup> The Hindu nationalism sweeping the country was further contributing to the discontent amongst many of the poor population.

India also had a very weak balance of payments with the international community; thus, it relied substantially upon foreign aid from the Soviet Union and the United States, as well as multilateral agencies such as the International Monetary Fund (IMF) and the World Bank.<sup>580</sup> The Executive Board of the IMF noted in their 1965 Annual Report that, ‘India continues to receive considerably less aid per capita than most other developing countries.’<sup>581</sup> Therefore, the IMF approved India’s next loan. The Indian government was also making economic changes in keeping with the IMF’s direction. The minutes of the IMF’s Executive Board meeting on July 12, 1967 record that:

The fund welcomes the major changes in India’s economic policies that have occurred since the last consultation. The change in the value of the rupee and the substantial liberalization of import restrictions together with the new priorities in the Fourth Plan should do much to increase the rate of economic growth.<sup>582</sup>

These notes continued to state that the Indian government was putting together a policy of financial constraints in order to bring its balance of trade (i.e., imports versus exports) into range

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<sup>579</sup> *ibid.*

<sup>580</sup> Chandra, *India Since Independence*, p. 456.

<sup>581</sup> *Annual Report, 1965*, International Monetary Fund, p. 94.

<sup>582</sup> International Monetary Fund, GATT - - Balance of Payments Consultations - - Acceptance of Invitation; Representation and Guidance for July Meeting, (1967), p. 2. Accessed at [www.imf.org](http://www.imf.org).

so that its exports could catch up to its imports. This sort of international economic assistance was not unusual; indeed, many other countries were mentioned in the minutes of the IMF meeting, including New Zealand, Pakistan, Spain, and Turkey.<sup>583</sup>

Furthermore, the cash reserves required to fuel India's strategy of large-scale industrialization put pressure on the rupee.<sup>584</sup> Since there was an overall shortage of currency, inflation dramatically increased.<sup>585</sup> One of the key areas that hurt India in the 1960s was foreign exchange and inflation. India's currency, a problem since independence, was under constant strain because the nation was expending so much of its reserves on building its infrastructure and other capital projects in an effort to shift its economy from an agrarian base to a modern structure. On July 3, 1965, India moved to ban the imports of roughly sixty items and placed import quotas on many others in order to help offset a 'serious shortage of foreign exchange.'<sup>586</sup> The move saved the country approximately \$4–6 million USD in 1965, but the ban deprived Indians to access of many medical devices and drugs.<sup>587</sup>

Given all of its economic challenges, the success of India's third and fourth five-year plans, which were executed during this period, was especially critical. During the first two five-year plans, the nation had invested a substantial amount of its cash reserves in agricultural stability; with those plans drawing to a close, India was now moving a substantial amount of its reserves to industrialization. Building on the first two plans, the third and fourth five-year plans were focused on expanding the industrial foundation of the first decade, giving the government

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<sup>583</sup> *ibid.*

<sup>584</sup> J. B. DeLong, 'India Since Independence: An Analytic Growth Narrative', in D. Rodrik (ed.), *In Search of Prosperity: Analytic Narratives on Economic Growth* (Princeton, 2003), p. 187.

<sup>585</sup> H. Feldman, 'Aid as Imperialism?' *International Affairs* (Royal Institute of International Affairs 1944), 43.2 (1967), p. 220.

<sup>586</sup> 'India Bans Imports of Certain Items', *New York Times*, 4 July 1965, p. 1.

<sup>587</sup> *ibid.*

greater independence from exports.<sup>588</sup> The plans also accelerated investment in agricultural growth, largely due to on-going issues in the production of wheat, corn, and rice.<sup>589</sup> One of India's successful strategies over the course of the 1960s was to increase production in the agricultural sector. The government identified districts where irrigation was available to focus on agricultural efforts.<sup>590</sup> The production of foodstuffs between 1963 and 1970 increased nearly four-fold, reducing India's vulnerability to famine.<sup>591</sup> This was a first for India and marked a substantial point of departure for a country that had grown all too familiar with famine over the previous half century. Although the actual growth rates for both five-year plans were lower than expected, they nevertheless laid the foundation for better growth in future years as the table makes clear.<sup>592</sup>

<i>Plans</i>	<i>Target Rate</i>	<i>Actual Rate</i>
First-Five-year Plan	2.1	3.6
Second Five-Year	4.5	4.0
Third Five-Year	5.6	2.4
Fourth Five-Year Plan	5.7	3.3
Fifth Five-Year Plan	4.4	5.0
Sixth Five-Year Plan	5.2	5.4
Seventh Five-Year Plan	5.0	5.7
Eighth Five-Year Plan	5.6	-

Source: Five-Year Plan documents.

Table 12: Target v. Actual Growth Rates during Five-Year Plans<sup>593</sup>

<sup>588</sup> India's Planning Commission, Third Five-Year Plans, Appendix B.

<sup>589</sup> S.A. Wolpert, *A New History of India* (Oxford, 1997), p. 378.

<sup>590</sup> M. Gadgil and R. Guha, *This Fissured Land: An Ecological History of India* (Berkeley, 1993), p. 85.

<sup>591</sup> R.E. Evenson and M.W. Rosegrant, 'Agricultural Research and Productivity Growth in India', *International Food Policy Research Institute*, 109 (1998), p. 30.

<sup>592</sup> L.N. Dash, *World Bank and Economic Development of India* (New Delhi, 2000), p. 114

<sup>593</sup> *ibid.*

Although India's economy was large, its exports remained stagnant.<sup>594</sup> In 1964, imports increased by around 19 per cent, whereas exports increased only by 6 per cent, resulting in a trade deficit.<sup>595</sup> In the years 1962-69, its growth rate in manufactured exports was 6.1 per cent, which left it ranked sixteenth out of seventeen leading countries, behind the likes of Chile, Columbia, and Iran.<sup>596</sup> Other developing nations such as South Korea, Taiwan, and Hong Kong saw rates of manufactured exports grow by 77 per cent, 36.5 per cent, and 20 per cent, respectively.<sup>597</sup> In sheer monetary terms, India had the developing world's third largest value of manufactured exports in US dollars in 1969, but it struggled to produce enough goods to meet the demand of its own country, much less be sold abroad. The same was true for medical technology: the production of machines, devices, and supplies was still growing within the subcontinent, but demand continued to outstrip domestic supply. India's need for vaccines, X-ray equipment, and contraceptive supplies and devices was largely met by imports.

In this regard, especially, India's policy of non-alignment was proving to be ever more useful. The government of Maharashtra and the local authorities in Bombay continued to benefit from the constant courting of resources, finance, and technical expertise. In fact, the stakes were significantly raised in the area of foreign policy competition in a politically polarized world. At the beginning of 1965, there was a meeting between the President of India, Dr. Radhakrishnan, and a delegation from the Soviet Union, at which the former stated that he hoped the economic ties between India and the Soviet Union would 'grow in the years to come and further strengthen

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<sup>594</sup> G. K. Helleiner, 'Manufactured Exports from Less-Developed Countries and Multinational Firms', *Economic Journal*, 83 (329) (1973), p.24.

<sup>595</sup> *Annual Report, 1965*, International Monetary Fund, pp. 93-4. Accessed 18 July 2014 at [www.imf.org/external/pubs/ft/ar/archive/pdf/ar1965.pdf](http://www.imf.org/external/pubs/ft/ar/archive/pdf/ar1965.pdf).

<sup>596</sup> Helleiner, 'Manufactured Exports', p. 24.

<sup>597</sup> *ibid.*

the bonds of friendship between two countries.’<sup>598</sup> The Russian delegation had arrived to celebrate the opening of several manufacturing facilities in oil exploration, oil refining and pharmaceutical and drug production. The same meeting also included an announcement that two additional projects for the manufacture of heavy pumps and ball bearings would soon commence. It was clear that the Soviet Union was attempting to keep pace with the West and maintain its influence over India with an industrial development collaboration that included drugs and pharmaceuticals. As we will see later in the chapter, Soviet support also provided key protection following India’s decision to place itself beyond international intellectual property law.

Finally, one of the major events of the period under review was the 1971 war between India and Pakistan. The war was short and resulted in victory for India; it also revealed a series of alliances between India, Pakistan, the United States, China, and the United Kingdom. Whilst the Soviet Union backed India, and the United States and China backed Pakistan, the United Kingdom attempted to remain neutral, providing aid to both nations. However, recently declassified documents strongly suggest that the UK was on the side of India, since it provided £7.5 million GBP in refugee relief for the Indians compared to only £1 million GBP in relief for Pakistan.<sup>599</sup> India’s swift victory over Pakistan brought some sense of stability to the region and ended conflict between the two nations for some time. Of lasting significance, it also resulted in the creation of newly independent East Pakistan, now known as Bangladesh. The tense but relatively stable peace between India and Pakistan provided a more solid grounding for India’s international medical technology complex to grow.

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<sup>598</sup> ‘Ten Years of Economic Aid: Russians Thanked’, *Times of India*, 2 February 1965, p. 7.

<sup>599</sup> National Archives of the United Kingdom, ‘Conclusions of a Meeting of the Cabinet Held at 10 Downing Street, S.W.1, on Thursday, 21 October 1971, at 11 a.m.’, (Jan. 1973).

## II. International Influence in Medical Technology

As we have already seen, India had a long history of receiving aid from the international community, whether from missionaries, corporations, multi-lateral agencies, or foreign governments. Indeed, the nation's reliance upon foreign entities for medical technology was a constant in its colonial as well as post-independence histories. This section shows how the international medical and public health communities helped to improve the production, distribution, and implementation of medical technology in India.

In the past, many multinational medical technology companies brought products to India only after the products were near the end of their life cycle and had generated sufficient profits in the West.<sup>600</sup> In 1964, the SPG was still trying to purchase medical technology abroad to improve its ability to treat patients and bolster its recruitment efforts. In a letter dated March 6, 1964, the St. Werburgh's Mission Hospital in Nandyal, received a letter from Siemens-Reiniger-Werke Corporation concerning the purchase of an X-ray unit.<sup>601</sup> Siemens had written to the SPG's headquarters in London to ascertain whether they intended to purchase an X-ray unit during that fiscal year. The SPG had written various letters concerning the purchase of exactly this sort of medical device. The exchange demonstrated how connected medical technology was, when one considers how active the SPG and other non-profit organisations were in their efforts to bring medical technology into India.<sup>602</sup>

Furthermore, India's reliance upon medical technology produced in foreign countries resulted in expensive repairs. In a letter dated September 12, 1966, a physician from London working as a medical missionary in St. Luke's Hospital in Lucknow described a broken X-ray

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<sup>600</sup> B. Bhandari, *The Ranbaxy Story* (New Delhi, 2005), pp. 66–9.

<sup>601</sup> Siemens-Reiniger-Werke Corporation representative. (6 March 1964). Letter to The Society for the Propagation of the Gospel in Foreign Parts. Special Collections & Western MSS (M337). Bodleian Library of Commonwealth and African Studies, Rhodes House, Oxford University Library Services, Oxford, UK.

<sup>602</sup> *ibid.*

machine that needed ‘very urgent’ repairs.<sup>603</sup> The hospital staff had been trying to arrange for the International General Electric Company to repair the X-ray machine since February 1965, more than 18 months earlier: ‘Due to one thing and another, especially the difficulty of importing spare parts, the job has not been done as yet’, noted the author of the letter. In the meantime, the rupee had been heavily devalued, meaning that the cost of importing the necessary parts from Germany had nearly doubled from Rs 4500 to over Rs 8000.<sup>604</sup> Having the X-ray machine out of commission for so long caused substantial problems to patient diagnosis and treatment at St. Luke’s.

A key element in the growth of the medical technology industry from 1964–72 was the emergence of globalization, which is commonly understood as the international integration of labour, capital, and commodities.<sup>605</sup> One particular factor in globalization was the collaboration of governmental and multi-lateral agencies to strengthen their influence over developing countries during the Cold War. But there was also the use of technology to meet the goals of religious organizations, private corporations, and foundations operating in India, whether for improving the greater good or making additional profits through expanding revenue bases. In the private sector, many pharmaceutical operations around the world were seeing lacklustre growth in new product development.<sup>606</sup> As a result of this general industrial decline, the research and development arms of life sciences companies expanded operations in new markets such as India and Latin America.<sup>607</sup> Though driven by vastly different objectives to those of foreign

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<sup>603</sup> D. De la Hoyde, Letter to Dr. Thres. Bodleian Library of Commonwealth and African Studies at the Rhodes House, 9 November 1966 (Special Collection & Western MSS), Oxford, UK.

<sup>604</sup> *ibid.*

<sup>605</sup> M.D. Bordo, A.M. Taylor, and J.G. Williamson (eds.), *Globalization in Historical Perspective* (Chicago and London, 2007), p. 2.

<sup>606</sup> D.W. Cray, ‘Drug Industry Sees Ways to Make up for New-Product Lag’, *New York Times*, 4 June 1967, p. 1.

<sup>607</sup> *ibid.*

governments, foundations, churches, and multi-lateral agencies, the pharmaceutical companies also aimed to improve medical technology in India.

One example of the shift to globalization in the international medical technology community was found in the Boots Healthcare report of June 1969. At its annual meeting, the CEO of Boots, a pharmacy and drug development company based in the UK, reported that the company's growth rate in developing countries had exceeded expectations.<sup>608</sup> Indeed, growth in overseas countries was at 23 per cent, with the bulk of the growth coming from India and Pakistan, underlining the growth in the drug market on the subcontinent in the years since 1964. Boots's sales growth also indicated that Western countries were beginning to reap the benefits of investing in India. Later in the meeting, the CEO of Boots Pure Drug Company Ltd., Timothy White, reported that the company would be expanding its Indian facilities and had been working in conjunction with the Indian government to develop a new site based outside Bombay.<sup>609</sup>

The presence of these foreign organizations, was reflected in classified advertisements from 1964–72. As stated above, in January 1967, Boehringer-Knoll Limited posted a request for a medical assistant. The assistant was expected to have a strong command of English and the ability to follow up with clinical trials programmes run by Boehringer.<sup>610</sup> Another example of the influence of foreign medical technology companies in India was in November 1968, when 'a leading International Pharmaceutical Company having elaborated research facilities abroad' advertised for a clinical researcher and physician collaborator. The advertisement specified that the candidate must have postgraduate qualifications in medicine with a background in

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<sup>608</sup> W.R. Norman, 'Boots Pure Drug Co Ltd: Timothy White's Integration Gives ... High Hopes for the Future', *Guardian*, 27 June 1969, p. 18.

<sup>609</sup> *ibid.*

<sup>610</sup> Classified advertisement 2 – No title. *Times of India*, 30 January 1967, p. 8.

pharmacology and biochemistry.<sup>611</sup> Many similar advertisements looking for clinical trial experience began with, ‘International pharmaceutical company requires...’<sup>612</sup> In October 1967, Suhrid Geigy placed an advertisement in the *Times of India* for a medical collaborator able to run clinical trials in India.<sup>613</sup> Suhrid Geigy was a joint venture between the Suhrid family and Geigy, Inc., and was one of many examples of international medical technology entities coordinating with Indians to form ventures that integrated the local market knowledge and international technology expertise.

The volume of classified advertisements over the 1950s, ’60s, ’70s, and into the closing decades of the twentieth century correlates directly with the growth of the medical technology industry and its need for human capital. The advertisements show that medical technology was starting to move away from an exclusive focus on manufacturing and distribution to the research and development side of the value chain. This growth eventually linked directly to India’s ability to become a world leader in medical technology diffusion as well as innovation. Overall, the frequency and the volume of clinical trial research classified advertisements during this period indicate how quickly medical technology had increased compared to the previous decade and a half.

### **III. An Educational Infrastructure Takes Shape**

Whilst national defence, agriculture, and manufacturing strategies were well formulated and handsomely financed in the first two five-year plans, the third five-year plan began to emphasize education, which had historically been a hindrance in the development and implementation of medical technology in the subcontinent. This commitment to education by the government

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<sup>611</sup> Classified advertisement 2 – No title, *Times of India*, 25 November 1968, p.3.

<sup>612</sup> Classified advertisement 19 – No title, *Times of India*, 20 February 1972, p. 13.

<sup>613</sup> Classified advertisement 26 – No title, *Times of India*, 27 October 1967, p. 6.

mapped out a clear strategy by which India would compete and grow in the more sophisticated areas of research and development in medical technology and other industries.

India's existing educational infrastructure did not meet the needs of the nation as it moved into its third decade of independence. Prime Minister Jawaharlal Nehru even described it as a system 'fit only to produce "babus" [clerks]'.<sup>614</sup> The first two five-year plans had devoted enormous resources and capital reserves on building the industrial base of India's economy. Funding for educational development was 7.0 per cent and 6.4 per cent of the budgets for the first and second five-year plans respectively.<sup>615</sup> For the sake of comparison, the first five-year plan devoted 28.1 per cent of the budget to irrigation and power, 23.6 per cent to transport and communication, 15.1 per cent to agriculture, 7.6 per cent to industry and mining, followed by education at 7.0 per cent.<sup>616</sup> The second five-year plan was similar, with education again ranked fifth in the total distribution of budget by major heads of development.<sup>617</sup> All this changed in the third five-year plan,

Education is the most important single factor in achieving rapid economic development and technological progress and in creating a social order founded on the values of freedom, social justice and equal opportunity. Programmes of education lie at the base of the effort to forge the bonds of common citizenship, to harness the energies of the people, and to develop the natural and human resources of every part of the country. Developments of the past decade have created a momentum for economic growth; yet, there are large deficiencies in the sphere of education, which must be removed speedily if progress is to be sustained and enduring. It is one of the major aims of the Third Plan to expand and intensify the educational effort and to bring every home within its fold, so that from now on, in all branches of national life, education becomes the focal point of planned development.<sup>618</sup>

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<sup>614</sup> K. Rangan, 'India Presses Technical Studies Under a "Nationalist" Program', *New York Times*, 13 January 1965, p. 85.

<sup>615</sup> India's Planning Commission, First Five-Year Plan. Accessed 18 July 2014 at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>, India's Planning Commission, Second Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

<sup>616</sup> India's Planning Commission, First Five-Year Plan.

<sup>617</sup> India's Planning Commission, Second Five-Year Plan.

<sup>618</sup> India's Planning Commission, Third Five-Year Plans, Chapter 29 – Education.

The third-five year plan allocated a total of 408 Rs. Crores for general education, whereas only 133 and 204 Rs. Crores were allocated in the first and second five-year plans, respectively.<sup>619</sup> The fourth five-year plan continued this emphasis on education.<sup>620</sup>

There were a number of individuals in the Indian government committed to bringing India into the developed world via educational resources. In an address to the World Conference of Education in November 1966, Asoka Mehta, a politician who helped organize the socialist wing of the National Congress Party, offered his thoughts on how India would join the modern world. He tied the importance of medical and biomedical education to a developed nation's social infrastructure, insisting that 'social infrastructure could not be given a secondary place.'<sup>621</sup> The Planning Commissioner continued by arguing that investment in medical education did not stop with improving the social infrastructure: 'the combination of valuation, institutional, and resource-endowment patterns of each nation is apt to call for measures of development which are often unique,' Mehta declared.<sup>622</sup> Furthermore, India's social and demographic problems were so varied and unique that it was impossible for the subcontinent to create a medical and biomedical educational infrastructure that simply mimicked others in its structure. India would need to forge its own path in order to reconfigure its social structure for the twenty-first century.

By 1965, India's current higher education system – both in general and specifically regarding medical technology – was still inadequate, even compared to other developing nations in Asia.<sup>623</sup> In a review by the Education Commission, formed in 1965 to advise the government

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<sup>619</sup> *ibid.*

<sup>620</sup> India's Planning Commission, Fourth Five-Year Plan, Chapter 16 – Education and Manpower.

<sup>621</sup> 'Building Up of Social and Economic India Structure: Simultaneous Efforts Urged by Mehta', *Times of India*, 23 November 1966, p. 9.

<sup>622</sup> *ibid.*

<sup>623</sup> 'Substandard Colleges are "Major Malady"', *Times of India*, 1 August 1965, p. 9.

on the state of education in India, Dr. D.S. Kothari found that the national education system in India had suffered from a decade of ‘uncontrolled expansion.’ The former Educational Adviser to the Government of India, Dr. K.G. Saiyadin asked whether a ‘substandard, unsatisfactory and incompetent education was better than providing no education at all.’<sup>624</sup> A *Times of India* article in January 1966 detailed more problems with India’s unbridled expansion of the education system throughout the previous decade.<sup>625</sup> The article pointed to a report released by the University Grants Commission which concluded that university admission was not selective enough, the cost of education was too high, and the pay for college and university instructors was too low. The article went on to state that India needed a larger budget, not a reform plan, a call the government heard to the tune of more than \$1 billion USD of investment in education before the end of 1972.<sup>626</sup>

The extraordinary expansion in educational funding, particularly in the areas of technology education in medicine and public health, extended to women, opening new professional and social opportunities. Such progress was in line with the general revolution in women’s rights occurring across much of the world at the time.<sup>627</sup> One programme launched in Gujarat in March 1971 declared that the cost of education for women would be paid for by the government until the end of the secondary stage.<sup>628</sup> This was part of a larger governmental effort to bolster educational opportunities for women in India: several conferences, commissions, and reports at the time resulted in more resources being put toward improving education in general,

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<sup>624</sup> *ibid.*

<sup>625</sup> ‘A Question of Costs’, *Times of India*, 12 January 1966, p. 8.

<sup>626</sup> *ibid.*

<sup>627</sup> R. Kumar, *The History of Doing: An Illustrated Account of Movements for Women's Rights and Feminism in India, 1800–1990* (New Delhi, 1997), p. 99.

<sup>628</sup> ‘Free Education for Women in Gujarat’, *Times of India*, 16 March 1971, p. 13.

particularly in the biomedical sciences for women, who were already fighting for additional rights across the country.<sup>629</sup>

#### **IV. The Birth of the Indian Patents Act of 1970**

There are few instances in which patents have become front page news, but the Indian Patents Act of 1970 is one example. This section will begin with a brief analysis of India's patent law and attempts to ease them. Second, this section will discuss how, after pressure from organizations like CIPLA, Indira Gandhi passed the Patents Act of 1970, in the process changing not only India's laws, but the face of international pharmaceuticals more generally. Finally, the Patents Act's effect on the medical technology industry in India and the world will be discussed: India's move provided an impetus for domestic medical technology development for decades to come and would be the spark that fuelled the fire of innovation.

Patent policies in India were first introduced into India by the British in the 1856 Act, which gave exclusive rights to inventors.<sup>630</sup> This law was amended in 1911 as the Patents and Designs Act, in an attempt to placate the Indian Communist Party. Following independence, the Patents Enquiry Committee was established in 1948 with the goal of revising India's patent structure.<sup>631</sup> An advertisement placed on December 30, 1948 by the Ministry of Industry and Supply in New Delhi began, 'The Central Government ... having appointed a Committee to examine and report upon the Patent Law of India and the working of the existing Patent System created by the Indian Patents and Designs Act of 1911.' The advertisement went on to request involvement from the public, specifically soliciting public feedback via a survey, noting that

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<sup>629</sup> R. Peppin Vaughan, 'Complex Collaborations: India and International Agendas on Girls' and Women's Education, 1947–1990', *International Journal of Educational Development* (2012), p. 118.

<sup>630</sup> D. Rangnekar, 'No Pills for Poor People? Understanding the Disembowelment of India's Patent Regime', *Economic and Political Weekly*, (41) 5 (2006), p. 410.

<sup>631</sup> *ibid.*

questionnaires regarding the application to the community could be obtained through the Secretary of the Patents Enquiry Committee.<sup>632</sup> Such notices demonstrate how quickly the independent Indian government recognized the problems with the existing patent system.

Soon after the creation of the Committee, the government amended the out-dated 1911 Act. In April 1949, just five months after the announcement of the formation of the committee, the Patent Enquiry Committee held its third meeting.<sup>633</sup> A year later, the committee's chairman, Dr. Bakshi Tek Chand, suggested that the government enact a law to replace the 1911 act.<sup>634</sup> The result was the Indian Patents and Designs Bill, passed by parliament on November 12, 1952. The bill affected both medicines as well as surgical curative devices. The new Act permitted the mass production of substances like mercury that were necessary for many of India's manufacturing processes.<sup>635</sup> Prior to the passing of the bill, India's total usage stood at 4-5,000 flasks per year, but once mercury was placed on the open general license list, its production rose to 37,000 flasks per year.<sup>636</sup> Such increases indicate the extent to which pre-existing patent laws had obstructed the production and development of medical technology in India. The next round of patent modifications began with the Ayyangar Committee of 1958 and 1960, established by the Indian government to bring about more rational intellectual property policies to suit a nation overwhelmed by poverty and deprivation.<sup>637</sup> The Ayyangar Committee Report was introduced into Parliament twice — in 1965 and 1967 — but failed to pass both times.<sup>638</sup>

India also tried to get other countries to ease patent restrictions, without success. Even Canada, a nation known to be friendly, did not compromise. In a series of letters between the

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<sup>632</sup> Display Advertisement 14 – No title, *Times of India*, 30 December 1948, p. 4.

<sup>633</sup> 'Patents Committee', *Times of India*, 19 April 1949, p. 4.

<sup>634</sup> 'Patents Bill Passed: Unanimously by Lok Sabha', *Times of India*, 30 August 1970, p. 6

<sup>635</sup> 'Indian Patents & Designs: Bill Passed', *Times of India*, 13 November 1952, p. 9.

<sup>636</sup> *ibid.*

<sup>637</sup> S.K. Sreedharan, 'On the Road to Commercialization of Patents in India', *Journal of Intellectual Property Law & Practice*, (7) 2 (2012), p. 112.

<sup>638</sup> *ibid.*, p. 113.

Office of the High Commissioner in Canada and the Minister of External Affairs, as well as Law Minister and Trade Minister, a draft of the Reciprocal Arrangements between Canada and India was developed.<sup>639</sup> The 66 pages produced between March 1952 and July 1955 constitute India's attempt to negotiate an improved status for patents and liberate itself from the patent law established by the British in 1911. The three years of communications culminated with a note from the Indian High Commissioner in Ottawa that no 'reciprocal agreements' could be reached with a Commonwealth country.<sup>640</sup> The Commissioner then attached the Convention between Canada and India Concerning the Priority of Patents of Invention.

Upon assuming power in 1966, there was increasing pressure on Indira Gandhi to further reform the 1911 laws, as Indians rallied for a revised patent system to provide a more economically feasible method to provide drugs to every citizen.<sup>641</sup> In the middle of the twentieth century, public health efforts around the world saw the increased use of medical technology in campaigns such as vaccination and family planning. These included liquids, pills, and devices, all of which had to be imported according to the provisions of the 1911 patent laws, which stated that the patent holder had to retain a share in the sale of the technology. The patent laws increased the price of medical technology in hospitals and clinics, lowering the potential for domestic manufacturing of the technology. As the public began to see the benefit of medical technology, the outcry over patent costs came to the forefront. For example, the British company ICI Pharmaceuticals, 'developed a potent high blood pressure medication called propranolol' that was too expensive for many developing countries.<sup>642</sup> Yusuf Hamied, a 34-year-old chemist and

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<sup>639</sup> NAI Ext. Affairs Min - 1953 - File No. - Progs. Nos. 3041 (71)-AMS, 1953.

<sup>640</sup> *ibid.*

<sup>641</sup> S. Kaviraj, 'Indira Gandhi and Indian Politics', *Economic and Political Weekly*, 21 (1986), p. 1700; 'Patent Folly', *Times of India*, 16 December 1964, p. 8.

<sup>642</sup> E. Check, 'The Treasure of Mumbai', *Wired Magazine* (December 2006). Accessed 18 September 2014 at <http://archive.wired.com/wired/archive/14.12/indiadrug.html>.

founder of CIPLA, pleaded to Prime Minister Gandhi, ‘Should millions of Indians be denied the use of a lifesaving drug just because the originator doesn't like the colour of our skin?’<sup>643</sup> With a change in law these companies could benefit financially from the ability to manufacture brand name medicines at more affordable prices. Furthermore, the affordable prices would make medicines more available to all Indians and to citizens of other developing countries.

Many journalists were also in favour of changing the patent law. In January 1965, Anthony Tucker, a columnist for the *Guardian*, published an article about the global medical technology industry in which he detailed the product development and distribution costs, as well as ethical issues, involved in the life-saving medicines that were produced by pharmaceutical manufacturers. Tucker inventoried the numerous issues that nations, health systems, and the public faced in trying to reconcile profitable industries that remained ‘seriously at odds with the societies they serve.’ At the end of the article, he concluded that the pharmaceutical industry should be subject to a ‘stronger and more formal machinery for hard bargaining...’<sup>644</sup> In other words, profits for companies should not come at the expense of lives in developing countries.

India’s existing patent laws were clearly an obstacle to Gandhi’s goal of providing increased healthcare delivery to a population in desperate need of greater access to medicines, medical devices, and medical supplies. In 1970, foreign medical technology firms controlled the vast majority of the medical technology products in the Indian market. As a result, India paid some of the highest prices in the world for those products. As Gandhi later put it at a World Health Assembly Speech of May 1981, ‘my idea of a better ordered world is one in which medical discoveries would be free of patents and there would be no profiteering from life or

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<sup>643</sup> *ibid.*

<sup>644</sup> *ibid.*

death.<sup>645</sup> Therefore, despite protests from large international pharmaceutical companies, Gandhi overhauled her nation's patent laws. Her determination to reform India's patent laws made an enormous difference to the pace of change; her policies, driven primarily by internal politics, had enormous ramifications for what was already one of the world's most significant industrial sectors.

The result of Indira Gandhi's reforms was the Patents Act of 1970. After years of debate, on August 29, 1970, India's representative house of government, the Lok Sabha, unanimously passed the act.<sup>646</sup> The effort to pass the bill had begun earlier that year; indeed, a joint committee of the Lok Sabha had been working on modifying the patent laws in India for several years.<sup>647</sup> Domestic firms hailed the new patent law as one that would accelerate the pace of medical technology growth within India. In a statement on September 16, 1970, the Indian Drug Manufacturers Association (IDMA) stated that, 'Indian drug manufacturers, scientists, and technocrats ha[ve] acquired sophisticated technology for manufacturer of new drugs and gained significant insight into new development.'<sup>648</sup> This was clearly a victory for the domestic medical technology industry in India.

The Act itself consisted of a dozen pages.<sup>649</sup> The definition section noted that the definition of medicines or drugs included, 'all medicines for internal or external use of human beings or animals', as well as several other substances and chemicals needed for the means of public health. The Act listed of inventions that could not be patented, including 'any process for the medicinal, surgical, curative, prophylactic [diagnostic therapeutic] or other treatment of

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<sup>645</sup> J. Mueller, 'The Tiger Awakens the Tumultuous Transformation of India's Patent System and the Rise of Indian Pharmaceutical Innovation', *University of Pittsburgh Law Review*, (68) 3 (2007), p. 496.

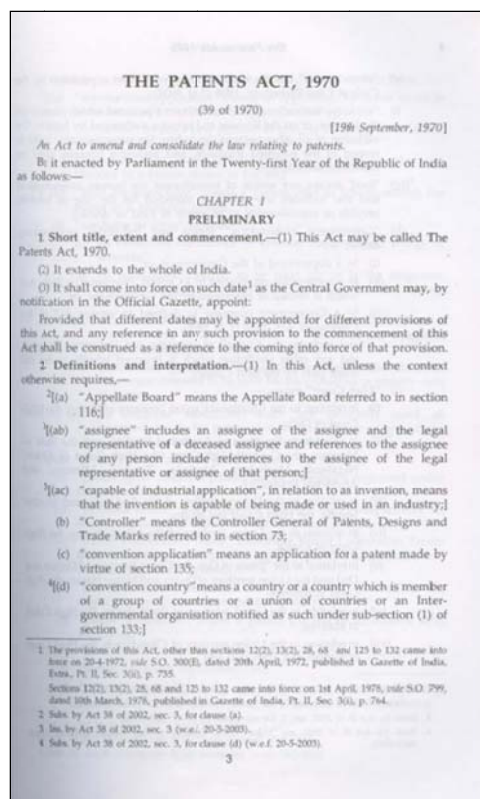
<sup>646</sup> 'Patents Bill Passed: Unanimously by Lok Sabha', p. 6.

<sup>647</sup> 'Joint Committee Cuts Period: Patent rights', *Times of India*, 28 February 1970, p. 11.

<sup>648</sup> 'Indian Drug Makers Hail New Patent Law', *Times of India*, 17 September 1970, p. 4.

<sup>649</sup> The Patents Act, No. 38 of 1970, §§ 116 (3), 117 (1). Accessed at <http://indiacode.nic.in>.

human beings or any process for a similar treatment of animals ... to render them free of disease or to increase their economic value or that of their products.<sup>650</sup> This broad definition of patent exemptions struck at the heart of the medical technology industry and encompassed virtually everything sold in India, including drugs, medical devices, diagnostic equipment, and medical supplies. The Patents Act was clearly aimed at reducing what had been a foreign monopoly within the Indian healthcare system. Perhaps more significantly, the Patent Act of 1970 effectively allowed domestic Indian medical technology firms to replicate the manufacturing process of hundreds of medicines, medical devices, and medical supplies.<sup>651</sup> This, in turn, allowed the cost of these medical technologies to be substantially lowered and accelerated their diffusion across Indian society.



<sup>650</sup> *ibid.*

<sup>651</sup> *ibid.*

Figure 5: The front page of *The Patents Act of 1970* that was passed in the Lok Sabha.<sup>652</sup>

Whilst most Indians favoured amending the British patent law, foreign corporations and patent attorneys based in India cautioned any changes.<sup>653</sup> Nonetheless, debate in India paid scant attention to the interests of foreign corporations or governments, focusing instead on whether the solution to India's impasse was to revise the existing patent system or abolish it outright.<sup>654</sup> It is important to keep in mind that during the 1960s and '70s, India was not alone in abolishing or substantially revising its patent laws. During these decades, many countries – including China, Turkey, the Soviet Union, and Egypt – either modified or entirely abolished patent protection laws for many medicines and medical devices.<sup>655</sup> Even European nations like Spain, Greece, and Portugal substantially weakened their patent protection laws.<sup>656</sup> Indeed, India was not even the first nation to take such measures: Turkey, for one, preceded it by several years.

The impact of the Patents Act was immediate, with a period of unprecedented growth in the medical technology sector. At the Bayer India Limited Annual Shareholder's Meeting on April 9, 1970, Chairman B.M. Ghia gave a speech outlining the status and progress of Bayer India over the previous year.<sup>657</sup> He first noted that sales had increased by 40 per cent in the year before, reaching an all-time high, before defending the profits of the pharmaceutical industry in India: 'We do not feel concerned about this, as we have entered the highly competitive Indian market only after the Government started to freeze the selling prices in 1963.' Ghia explained

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<sup>652</sup> Government of India, NAI, 1970, p. 3. Accessed at [www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCAQFjAA&url=http%3A%2F%2Fipindia.nic.in%2Fipr%2Fpatent%2Fpatent\\_Act\\_1970\\_28012013\\_book.pdf&ei=WqcmVM3aC4SkyQS9-4CgCQ&usg=AFQjCNHXLm6vNMP3Ozjb27cqkNprVlsiw&sig2=wIT2sobd5cnezmdr23cysg](http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCAQFjAA&url=http%3A%2F%2Fipindia.nic.in%2Fipr%2Fpatent%2Fpatent_Act_1970_28012013_book.pdf&ei=WqcmVM3aC4SkyQS9-4CgCQ&usg=AFQjCNHXLm6vNMP3Ozjb27cqkNprVlsiw&sig2=wIT2sobd5cnezmdr23cysg)

<sup>653</sup> 'Patent Law: To the Editor', *Times of India*, 20 January 1965, p. 8.

<sup>654</sup> 'Ministries Divided on Patent Bill', *Times of India*, 13 February 1964, p. 3.

<sup>655</sup> I. Eren-Vural, 'Domestic Contours of Global Regulation: Understanding the Policy Changes on Pharmaceutical Patents in India and Turkey', *Review of International Political Economy*, 14 (1) (2007), p. 106.

<sup>656</sup> *ibid.*, p. 110.

<sup>657</sup> 'Bayer (India) Limited: Speech of the Chairman, Mr. B.M. Ghia', *Times of India*, 9 April 1970, p. 9.

that Bayer India had continued to be profitable even under the government's mechanism of price controls for multinational corporations.<sup>658</sup>

Prior to the Act, most drugs in India were imported, but in the aftermath of 1970, many native pharmaceutical companies began manufacturing drugs. Since then, the Patents Act has been responsible for an average annual rate of six per cent economic growth in India for the past twenty years.<sup>659</sup> The advantages afforded by the new law could be seen with the antibiotic Ciprofloxacin (CIPRO). Blue Cross Laboratories, an Indian pharmaceutical company, began producing a 500mg tablet of CIPRO for 4 cents, a wholesale price of 7 cents, and a consumer price in the Indian drugstores of about 10 cents. By contrast, the patent holder Bayer offered CIPRO tablets to the U.S. Government for 95 cents during the anthrax scare after September 11, 2001, more than 60 times more expensive than the cost in India.<sup>660</sup>

CIPLA also capitalized on the change in India's patent laws. One of the most significant examples of CIPLA producing cheaper drugs is combination drug therapy for AIDS. In 1993, CIPLA offered the virus-inhibiting combination therapy drug Zidovudine for significantly less than Western companies, with other drugs like Stavudine, Lamivudine and Nevirapine to follow.<sup>661</sup>

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<sup>658</sup> *ibid.*

<sup>659</sup> R. Gerster, 'People Before Patents: The Success Story of the Indian Pharmaceutical Industry', *Bulletin von Medicus Mundi Schweiz* (84) (2002), p. 5.

<sup>660</sup> *ibid.*, p. 1.

<sup>661</sup> *ibid.*, p. 3.

## V. The International Community Responds

The Patents Act of 1970 caused reverberations in the global medical technology complex that were based as much on corporate and political alignment as institutional missions. This section reviews how the international community responded to the Act in both words and deeds.

Within the multinational for-profit corporation community, the reaction to India's move was predictably negative. Shoichi Inouye, a former director of the Japanese Government Patent Office, stated that the Indian action would 'seriously weaken patent rights for government purposes and at the discretion of the Indian Government.'<sup>662</sup> Japan and its trade delegates were not the only groups to complain about India's new patent regime: many firms from other developed countries were similarly disappointed with the changes in the patent regulation. In November 1970, the American pharmaceutical manufacturer Merck, Sharp, and Dohme was quoted in the *New York Times* stating that, 'The law is based upon the premise that it will help India become more self-sufficient, whereas, in areas of high technology, it actually will tend to isolate India from the established functioning centres where such technology is created.'<sup>663</sup> E.G. Hess, the Vice-President of American Cyanamid, argued that 'the patent bill will seriously reduce research-oriented companies to expand or even continue their operations in India.'<sup>664</sup> The new patent regime law threatened their markets not only in India, but in other developing nations as well.

The fissure in relations with the profit making sector of medical technology companies was the short-term consequence of India's new patent regime. But the long-term implications for India's place in the international medical complex were very different: aside from the

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<sup>662</sup> 'Japan Attacks Indian Move for Patent Law', *Times of India*, 14 September 1967, p. 9.

<sup>663</sup> W.E. Sauro, 'India Curbs Patents: New Law Upsets Some US Companies', *New York Times*, 15 November 1970, F14.

<sup>664</sup> *ibid.*

multinational medical technology corporations, the international community continued to assist the world's largest democracy with the requisition and distribution of various types of medical technologies.<sup>665</sup> This can be seen throughout documents in the archives of the Ford and Rockefeller foundations, as well as the support of the International Monetary Fund and World Bank.<sup>666</sup> Multilateral agencies, medical missions, and most major governments continued to work with India despite the nearly complete revision of intellectual property law represented by the Patents Act.

Arguably, India's foreign policy of non-alignment provided political cover for the Act. Given the fierce competition between the free-market capitalist countries and the centrally controlled communist nations for India's loyalties, a negative reaction from the West risked driving India into the Soviet Union's sphere of influence. As vociferously as multinational medical technology corporations might have protested, neither Western governments nor major international multi-lateral agencies were in a position to respond. Thus, whilst many of the international corporations were up in arms over the patent law, most other elements of the medical technology complex, including the World Health Organization and the Rockefeller Foundation, continued to provide support to India.<sup>667</sup> Therefore, there was growth in medical technology, predominantly in the prevention and treatment of malaria, tuberculosis, and smallpox, as well as new clinical infrastructure and research funding.<sup>668</sup>

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<sup>665</sup> Feldman, 'Aid as Imperialism?', p. 220.

<sup>666</sup> Mayhew, 'Clarence Ayres, Technology, Pragmatism, and Progress', p. 214.

<sup>667</sup> J. Roger, 'New Patterns in Health Sector Aid', *Economic and Political Weekly*, (17) 37 (1982), p. 1498.

<sup>668</sup> *ibid.*

## VI. Medical Research Progresses: From Subject to Scientist

During the years 1964–72, India continued to expand its medical technology research and development capacity. In January 1964, a missionary working for the SPG at the Holdsworth Memorial Hospital in Mysore reported on the training procedures for several technology related degrees offered at the hospital, predominantly paramedical professions such as pharmacists, laboratory technicians, radiographers, physiotherapists, medical social workers, and hospital business managers.<sup>669</sup> The letter noted that Christian schools were offering pharmacy training across the country, including Varanasi, Waltair, Nagpur, Chandigarh, Saugor, Ahmedabad, and Madras.<sup>670</sup> The letter also detailed twelve training schools for laboratory technicians that had opened in India since independence, as well as four Christian institutions in India offering training in radiography.

This section will explain how India started focusing on clinical trials, contraception, developing vaccines, expanding the use of surgical interventions, and establishing research programmes. Secondly, this section will show how India was undergoing a shift from traditional, indigenous medicine to the practices based upon Western science and technology. Finally, it will discuss the disparity in diffusion of technology in the various regions of India, a serious issue with which the nation had to contend.

The evidence for the growth of the clinical trials sector in this period is overwhelming. Private industry and government support was supplemented with foundation support for many different types of clinical trials, including by the wide-ranging efforts of the Council of Scientific and Industrial Growth funded by the Indian Government.<sup>671</sup> Furthermore, there were many

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<sup>669</sup> D.M. Barton, Letter to Dr. Thres. 27 January 1964. Special Collections & Western MSS (M354). Bodleian Library of Commonwealth and African Studies, Rhodes House, Oxford University Library Services, Oxford, UK.

<sup>670</sup> *ibid.*

<sup>671</sup> Classified advertisement 6 – No title, *Times of India*, 24 September 1966, p. 11.

advertisements posted for clinical trials researchers. In September 1966, the Indian Institute of Experimental Medicine in Calcutta advertised a position for an MD or PhD in pharmacology with a background in clinical trials and a minimum of four years of experience in research.<sup>672</sup> In 1967, Boehringer-Knoll Limited, a joint venture between Germany's Boehringer-Mannheim and Knoll, placed an advertisement for a medical assistant with experience in clinical trials.<sup>673</sup> Another advertisement in 1967 requested a postgraduate doctor with clinical trial experience to record observations on products that were being studied at a hospital in Bombay.<sup>674</sup>

The development of medical technology went beyond clinical trials: India was now also producing its own substantive medical research. In 1967, research programmes were established by Dr. N.L. Shah of Biotech Laboratories in Poona.<sup>675</sup> His laboratory started mass producing biological micro-slides needed for medical research that were distributed throughout India; soon they were being produced in Seoul and exported to East Africa, Ghana, and West Germany.<sup>676</sup> India also started to develop vaccines: in October 1968, the Council of Scientific and Industrial Research announced that it was conducting clinical trials on animals for a new oral cholera vaccine developed by the Indian Institute of Experimental Medicine in Calcutta.<sup>677</sup> An oral vaccine was deemed necessary since the World Health Organization had deemed the injectable vaccines to be inadequate.<sup>678</sup> The Council administered the oral vaccine to twenty-five staff volunteers to establish its safety in controlled field trials.

The development of new vaccines was a new and burgeoning area of Indian medical technology. A 1972 commentary on the drug industry issued by Prime Minister's office provides

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<sup>672</sup> *ibid.*

<sup>673</sup> Classified advertisement 2 – No title, *Times of India*, 30 January 1967, p. 8.

<sup>674</sup> Classified advertisement 7 – No title, *Times of India*, 2 August 1967, p. 2.

<sup>675</sup> 'Micro-Slides Sent Abroad: Poona Venture: "Times of India" News Service', *Times of India*, 14 August 1967, p. 8.

<sup>676</sup> *ibid.*

<sup>677</sup> 'Oral Cholera Vaccine for Field Trials', *Times of India*, 21 October 1968, p. 11.

<sup>678</sup> *ibid.*

further insight as to how the Indian government pursued its basic vaccination development and production schedule over the next 30 years.<sup>679</sup> It stated that India must become self-sufficient in the production of some of the most basic, life-saving drugs. A process of ‘Indianisation’ must take place, the report continued, so that the country could not only produce medicines without import, but also the basic ingredients for their production. The paper also stated that whilst indigenous medicines, ‘serve a majority of the population’, there were no means for mass production, an issue which needed to be rectified. Finally, the insulin monopoly held by Boots Pharmaceuticals was seen as problematic: ‘the shortage of insulin in the country could be artificial and not necessarily due to the shortage of pancreas.’<sup>680</sup> India was slowly developing plans to correct its shortcomings in medical technology.

In addition, the Indian population was becoming more accepting of Western medical techniques like vaccines and surgery. To take one example, the progress made by missionaries in their goal of immunizing the population against diseases was summarized in a letter dated May 17, 1971, in which a medical missionary wrote that over 3,000 immunizations had been administered in six months.<sup>681</sup> The vaccinations had been the triple-antigen for diphtheria, tetanus, and whooping cough, typhoid, and cholera. The missionary reported that it was still difficult in some of the more remote villages to immunize children because of a lack of cooperation from parents and local practitioners: ‘The local doctors are not always cooperative. One of them told me that he would lose his custom.’<sup>682</sup> There was also more acceptance of surgical interventions: the missionary’s letters note that St. Luke’s Hospital, in the Moradabad

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<sup>679</sup> “Comments on the Paper on Drugs and Pharmaceuticals,” Prime Minister’s Office, File No. 17-1315 (1972), NAI.

<sup>680</sup> *ibid.*

<sup>681</sup> L. L. Jensen, Letter to Dr. K. Wright. Bodleian Library of Commonwealth and African Studies at the Rhodes House, 17 May 1971 (Special Collection & Western MSS), Oxford, UK.

<sup>682</sup> *ibid.*

district in Uttar Pradesh, saw an increase in patients coming in for major surgery.<sup>683</sup> Surgical interventions had been growing for a number of years, and the fact that many people chose to be operated upon in a Christian hospital showed the success of the diffusion process of Western medicine in India. Barriers to better healthcare were slowly being removed.

The social health programmes that were part of the growing acceptance of Western medicine across India were largely funded or staffed by the international medical technology complex. Supported by foreign foundations and government agencies in India, hundreds of thousands of public health professionals created educational materials, programmes, and forged personal relationships with villagers and urban dwellers alike to affect a change in values within Indian society.<sup>684</sup> In an edited volume entitled *Innovations in Health and Medicine*, Jennifer Stanton discussed the need for shifts in cultural values in order to produce medical technology change, noting that the medical technology industry expended an extraordinary amount of effort to ensure that Indian society embraced the usage of many medical technologies.<sup>685</sup>

Despite all the progress made in medical technology, there remained inconsistencies in the diffusion of science and technology. For example, by 1972, the northern state of Punjab was twice as wealthy as the poorest state in India, Manipur.<sup>686</sup> In a report from St. Luke's Hospital in the Moradabad district of Uttar Pradesh, Pauline Taylor, a physician missionary in India, described the lack of resources and detrimental effect on levels of patient care.<sup>687</sup> Her report listed several issues preventing doctors' ability to dispense medicines and vaccinations. Aside

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<sup>683</sup> S. Bhattacharya, M. Harrison, and M. Worboys (eds.), *Fractured States: Smallpox, Public Health and Vaccination Policy in British India, 1800-1947* (London, 2005), p. 225.

<sup>684</sup> *ibid.*, p. 60.

<sup>685</sup> J. Stanton (ed.), *Innovations in Health and Medicine: Diffusion and Resistance in the Twentieth Century* (London, 2002).

<sup>686</sup> D. Banik, 'Growth and Hunger in India', *Journal of Democracy*, (22) 3 (2011), pp. 90–104.

<sup>687</sup> F. Taylor, Letter to the United Society for the Propagation of the Gospel, 27 November 1971, Bodleian Library of Commonwealth and African Studies at the Rhodes House. (Special Collection & Western MSS: ON 3), Oxford, UK.

from a lack of electricity, which meant there were no light bulbs at night, there was insufficient power to run the refrigerators that preserved vaccines and ran the water.<sup>688</sup> Inadequate electricity was not especially unusual in India, but an adequate electricity supply is crucial to the diffusion of medical technology. Whilst many areas had electricity, it often failed as power grids were attacked, which meant that operating theatres could not reliably conduct their operations. Perhaps as a result, major indicators such as life expectancy, income, and literacy were relatively unaffected, with significant regional disparities in these areas.<sup>689</sup> Thus, there remained a substantial amount of work to do in order to ensure that the nation as a whole was reaching equitable levels of nutrition, literacy, and economic growth.

## **VII. Conclusion: Burning Bridges, Building Bridges**

This chapter has examined the critical period in which India began to enter the global medical technology complex as a producer, rather than just a consumer. From the drafting of the third five-year plan, with its focus on improving education, to the movement away from the international intellectual property community, the years 1964–72 proved to be seminal for the development of India’s medical technology. This period demonstrated the resilience of the country in the face of multiple wars, economic instability, and social turbulence. The shift from a conservative ruling Congress Party to one aligned with the mass of India’s population had massive ramifications for India’s medical technology industry, paving the way for the Indian Patents Act in 1970, which resulted from over two decades of debate within India’s medical technology and political circles.

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<sup>688</sup> *ibid.*

<sup>689</sup> D. Banik, ‘Growth and Hunger in India’.

The influence of international global politics and India's policy of non-alignment continued to accelerate the growth of medical technology. What began in the 1950s as a competition for influence between the Soviet Bloc and the West grew stronger as the 1960s turned into the '70s. As progressively more developing nations opted out of international patent laws, and as a strong secondary market for the more affordable medical technologies grew, India had more of an incentive to reject the laws. Coupled with the fact that India was being courted by both the Soviet Union and the West, the nation was afforded an unprecedented level of political cover, reducing the risks of such a bold policy move. New markets for Indian medical products opened in the Soviet Bloc, as well as developing countries. This trend, in turn, drove India's medical technology industry toward a more socialist model. Although it took a long time to emerge, the various revisions in the post-independence years – from the Patent Enquiry Committee to the Ayyangar Committee of 1958 – created a patent policy favourable to both India's domestic public health infrastructure and its international medical technology exports.

Beyond the patent laws, there were many other trends affecting the development of India's medical technology during this period. As a result of the third five-year plan, India's educational system was reaping the same benefits that agricultural and industrial development had seen under the first two five-year plans.<sup>690</sup> The importance of the expansion of education for medical technology was clear, with an abundance of skilled workers fuelling the growth of India's medical technology industry. Indeed, without a thriving educational system, innovation is impossible. The steps that India took in shoring up its educational system were critical to its emergence as a centre for technology innovation.

Education was not simply a matter of teaching students how to manage the medical technology production process; also fundamental was the ability to conduct medical research via

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<sup>690</sup> India's Planning Commission, Third Five-Year Plan.

what is known as good clinical practices. The shift away from medical research in India being conducted by foreign institutions to it being conducted by local organizations was a hallmark of the period under review. India's self-sufficiency in medical research, like its advances in general education, became critical to the development of its medical technology as the nation forged its own path after 1970. The medical technology community in India was no longer reliant upon Western experts to help further its medical technology research, which nearly eliminated any short-term risk of losing access to the drugs and devices of multi-national corporations by breaking with international patent law.

In the short term, the passage of the Patents Act severely hampered India's ability to work with private medical technology corporations from the developed world. On the other hand, the consequences for India's domestic medical technology industry, and in particular its pharmaceutical industry, were clearly favourable. India's divergence from international intellectual property standards marked a period of long-term growth that saw the nation become a global power in medical technology sales. As a 2005 *New York Times* editorial put it, 'If Parliament can preserve India's ability to provide generic versions of these medicines; it will make the difference between life and death for millions of people at home and abroad.'<sup>691</sup> India's ability to find a middle way between abolishing the patent system outright and adhering to the strictures of international patent law provided it with a huge secondary market in developing countries. The Patents Act turned out to have far reaching implications that few at the time recognized.

In 1972, on the occasion of India's twenty-fifth anniversary of independence, Indira Gandhi published an article in the journal *Foreign Affairs* that discussed several critical areas of growth in India, including 'the development of our industry and agriculture, our science and

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<sup>691</sup> 'AIDS Drugs Threatened', *New York Times*, 5 March 2005, A12.

technology, our education and health.<sup>692</sup> She clearly felt that India had made good progress in these six critical areas; given the tumultuous decade that had preceded it, 1972 seemed an especially favourable moment on which to reflect on many of the points of progress that India had made in twenty-five years. Gandhi's positive political reflections were not unjustified, but many challenges awaited her and the country over the coming years.

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<sup>692</sup> I. Gandhi, 'India and the World', *Foreign Affairs*, 51 (1) (1972), p. 66.

## Chapter 6: India's Medical Technology Industry Continues to Develop as the World Joins to Eradicate Smallpox – 1973 to 1984

‘Smallpox was once considered to be “too insidious to eradicate.” Its elimination is an outstanding example of what can be accomplished by mankind when nations work together toward a common goal. ... The success of the eradication campaign serves to remind us all that international cooperation is invaluable for battling and solving common problems.’<sup>693</sup>

– *Report of the Health Survey and Development Committee*, Vol. II, 1946

India's medical technology industry grew at a rate hitherto unseen in the republic's short history. Indeed, according to a report published in India in 1989, the nation's drug industry growth was consistent from 1973 to 1984.<sup>694</sup> India was now free from international property law and, thanks in large part to the aid from the West and the Soviet Bloc nations, it had a solid infrastructure of medical and biomedical education.<sup>695</sup> The nation had finally achieved self-sufficiency in the production of most critical life science pharmaceuticals and many medical devices.<sup>696</sup> The production processes that India was using were, for the most part, state of the art and adept at producing high quality medical devices, pharmaceuticals, and supplies.<sup>697</sup> The number of medical technology manufacturers reached an all-time peak.<sup>698</sup>

India's medical technology was growing, a fact that Indians were proud of.

Unsurprisingly, India enjoyed announcing to the world that its medical technology had emerged to the point where it was having a global influence. An article published in February 1973 stated that, ‘India today can boast of a pharmaceutical industry which is outranked in sophistication and

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<sup>693</sup> C. Everett Koop, M.D., Surgeon General of the U.S. Public Health Service, ‘Remarks for the Smallpox Eradication Celebration’, presented to the Centers for Disease Control, Atlanta, Georgia, 29 October 1987. Accessed 24 July 2014 at <http://profiles.nlm.nih.gov/ps/access/QQBBQS.pdf>.

<sup>694</sup> H. Ahmad, *Technological Development in Drugs & Pharmaceutical Industry in India* (New Delhi, 1988), p. 3.

<sup>695</sup> B. Chandra, *India Since Independence* (New Delhi, 2008), p. 456.

<sup>696</sup> N. Chatterji, ‘Giant Strides Made by Our Pharmaceutical Industry’, *Times of India*, 12 February 1973, p. 19.

<sup>697</sup> Ahmad, *Technological Development*, p. 3.

<sup>698</sup> *ibid.*, p. 116.

complexity only by the United States and less than half a dozen European countries.<sup>699</sup> This statement was followed by close to 1,000 words praising the growth and quality of the domestic life science sector in India. To give one a feeling for just how large the market was, none of the manufacturers held more than a 15 per cent share of the market (See Table 13), resulting in a true free market medical technology economy.<sup>700</sup>

<i>Number</i>	<i>Rank</i>	<i>Name of Company</i>	<i>Market share %</i>
1	1	Sarabhai	7.1
2	2	Glaxo (UK)	6.2
3	3	Pfizer (USA)	5.9
4	4	Allembic	4.2
5	5	Hoechst (Germany)	3.6
6	6	Lederle (USA)	2.5
7	7	Parke-Davis (USA)	2.3
8	7	Abbot (USA)	2.3
9	7	Ciba-Geigy (Swiss)	2.3
10	8	Sandoz (Swiss)	2.2
11	9	Burroughs-Wellcome (UK)	2.1
12	10	Boots (UK)	2.0
13	10	Suhrid	2.0
14	11	Unichem	1.9
15	11	E. Merck (USA)	1.9
16	11	John Wyeth (USA)	1.9
17	11	M&B (USA)	1.9
18	12	SKF (USA)	1.6
19	12	German Remedies	1.6
20	12	MSD	1.6

*Table 13: The ranking of drug companies by market share in India during 1976*<sup>701</sup>

However, the government was still imposing strict regulations and licensing policies on companies operating in India. The measures included not only restrictions on investment and tariffs, but also various levels of direct government investment in the medical technology

<sup>699</sup> Chatterji, 'Giant Strides Made by Our Pharmaceutical Industry', p. 19.

<sup>700</sup> S.V. Ramani and M.S. Venkataramani, 'Rising to the Technological Challenge: Possibilities for Integration of Biotechnology in the Indian Pharmaceutical Industry', *International Journal of Biotechnology*, 3 (1) (2001), p. 95.

<sup>701</sup> *ibid.*

companies themselves.<sup>702</sup> Although predominantly privately owned, these manufacturers worked within the government's regulatory structure. A press note on industrial policy dated February 2, 1973 made it clear that most companies were not permitted new undertakings, diversification or expansion.<sup>703</sup> Furthermore, licensing and import authorities had to give clearance for investment in machinery or raw material imports and only the government could import consumer goods.<sup>704</sup> The strict regulations led to slow industrial growth during the beginning of the 1970s, therefore the government started to slowly deregulate industry.<sup>705</sup> There was an unprecedented jump not only in the domestic growth of this area, but also in its international growth during 1974–82.<sup>706</sup> The Indian government's various new tax policies also incentivized foreign investment into the Indian medical technology industry.<sup>707</sup>

During this change in industrial regulation, communal violence, much of which had been long standing in Indian history, flared up.<sup>708</sup> Decades after the Partition, simmering tensions between Hindus and Muslims came to a head over a variety of economic differences.<sup>709</sup> One such instance was a wave of riots between Muslims and Hindus across Gujarat and the cities of Ahmedabad and Baroda.<sup>710</sup> But whilst these riots were unprecedented in their brutality, they were eventually quelled in the so-called Indian emergency, a period of twenty-one months in which Prime Minister Indira Gandhi declared a state of emergency, suspending elections and most civil

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<sup>702</sup> I. Eren-Vural, 'Domestic Contours of Global Regulation: Understanding the Policy Changes on Pharmaceutical Patents in India and Turkey', *Review of International Political Economy*, 14 (1) (2007), p. 115.

<sup>703</sup> A. Panagariya, *India: The Emerging Giant* (New Delhi, 2008), pp. 78–9.

<sup>704</sup> *ibid.*, p. 79.

<sup>705</sup> *ibid.*

<sup>706</sup> Ahmad, *Technological Development in Drugs & Pharmaceutical Industry in India*, p. 116.

<sup>707</sup> V.M. Peter, I.A. Keer, and M. Thorpe, 'Tax Policy in India', *Asian Journal of Public Administration*, 24 (2002), p. 118.

<sup>708</sup> A. Varshney, *Ethnic Conflict and Civic Life: Hindus and Muslims in India* (New Haven, 2003), p. 95.

<sup>709</sup> *ibid.* p. 180.

<sup>710</sup> R. Guha, *India After Gandhi* (New Delhi, 2007), p. 656.

liberties.<sup>711</sup> The declaration was required after extraordinary levels of corruption and economic stagnation, which resulted in people viewing the government as less credible than at any time since the beginning of independence.<sup>712</sup> These emergency measures, which allowed curfews and the arrest of dissidents, were eventually lifted in 1977, after which Gandhi's Congress Party was beaten badly in the polls. This period ended in yet more violence, with the assassination of Indira Gandhi on October 31, 1984.<sup>713</sup> The continuation of a political dynasty was assured with Indira's son Rajiv winning an overwhelming victory in the December 1984 parliamentary elections.<sup>714</sup> As we shall see in the next chapter, Rajiv's ascent was a boon to India's emergence in the global medical technology complex, as he began to liberalize the Indian economy in ways few could have imagined.

This chapter will examine how modern technology in India grew during 1973–84. The first section will discuss the factors that brought about the growth of India's medical technology industry. The second will further examine how the process-focused Patents Act of 1970, and other aspects of India's regulations, aided this growth. The third section will examine how India developed its medical education infrastructure. Then the eradication of smallpox will be used to illustrate the power of bringing different countries and international organizations together. The way the Smallpox Eradication Programme operated is a great example of the great power of the medical technology complex. Finally, the different theories of diffusion of Western science and technology will be evaluated, since any program or complex that works for improving medical technology and the health of the world needs to understand the best way to diffuse that technology.

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<sup>711</sup> W. Borders, 'Emergency in India Entering New Phase', *New York Times*, 26 December 1975, p. 65.

<sup>712</sup> D.R. Gwatkin, 'Political Will and Family Planning: The Implications of India's Emergency Experience', *Population and Development Review*, (5) 1 (1979), pp. 22–59.

<sup>713</sup> D. Rothermund, *An Economic History of India* (New York, 1988), p. 164.

<sup>714</sup> *ibid.*

## **I. Factors that Caused the Growth of Medical Technology**

Several converging factors brought about the rapid growth of medical technology in India. First, there was the reformation of India's patent laws heralded by the Patents Act of 1970. The state also began to develop medical education programmes in an attempt to overcome inequalities in access to medical education across the various regions of India. Thirdly, India's abundance of natural resources was finally capitalized upon, which led to an increase of foreign and domestic investment. India's potentially massive domestic market, burgeoning educational system, and natural resources provided it with an attractive investment advantage that few other countries could match. India also infiltrated the international market as a pharmaceutical exporter by creating trade relationships with various countries and maintaining its relations with the United States. Finally, newspaper articles detailing the exploitation of Third World countries by Western medical technology companies provided international support for India's medical technology market.

After the Patents Act was passed in 1970, there was a perceived need to reduce the price of drugs.<sup>715</sup> Throughout the course of India's independence, there had been a desire to become self-sufficient in medical supplies, pills, and devices, a goal that was a significant driving force behind the Patents Act.<sup>716</sup> By the late 1960s, frustration with the cost of drugs had peaked. The movement away from centrist and moderate policies gave way to a more left-leaning government, leading to the Patents Act.<sup>717</sup> In an October 1973 article, the head of the pharmaceutical producers of India, Arvind Nair, explained that there had been no drug price increases over the previous three years.<sup>718</sup> Whilst the wholesale price in India had shot up

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<sup>715</sup> A. Tucker, 'Drugs Today', *Guardian*, 26 January 1965, p. 10.

<sup>716</sup> *ibid.*

<sup>717</sup> 'Patents Bill Passed: Unanimously by Lok Sabha', *Times of India*, 30 August 1970, p. 6.

<sup>718</sup> A. Nair, 'Drug Prices', Letter to Editor, *Times of India*, 4 October 1973, p. 4.

substantially during that period, the price index for medicines was largely unchanged. The price reductions also included a substantial number of lifesaving drugs such as antibiotics, anti-tuberculosis medications, and various vaccines and diabetic drugs.<sup>719</sup> All of this allowed political leaders in India to claim that life for common Indians was improving. In an environment in which infectious diseases were still rampant, there was no greater need than that of cheap vaccine production. The reformation of laws and the effect on medical technology will be discussed in more detail in the next section.

In addition, India began to develop its medical education infrastructure during this time. As the third full decade of the educational programmes launched by the five-year plans was enacted, and as medical technology grew with the self-sustaining production of devices and drugs, a host of new opportunities emerged within this growing sector. Educational programmes to train biomedical engineers developed as opportunities proliferated. As markets for medical technology sales grew in India, more investments poured in from within the country, as well as from communist-leaning nations and Western democracies. These investments were centred on building new manufacturing plants for medical devices, supplies, and pharmaceuticals. Usage increased with production, such that an entire generation of personnel was now needed not only for research, development, distribution, sale, and administration, but also for educating the new personnel needed in these areas. However, the development of educational programmes was not consistent throughout all of the Indian states. The state of education during this time will be discussed in more detail in a following section.

As discussed in Chapter 2, India had many natural resources like jute and chromite, and over thirty plants that could be used for alternative Indian native medicine, i.e. Ayurvedic

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<sup>719</sup> *ibid.*

pharmaceuticals, all of which enabled the growth of medical technology.<sup>720</sup> Pharmaceutical companies like E.R. Squibb & Sons and Merck were very interested in the existence of obscure yet commercially viable plants, including vines, roots, and other botanicals.<sup>721</sup> These medical technology groups dispatched ‘plant detectives’ throughout India to find promising medicinal botanicals to create new products such as Valium and hormones or other drugs for use in treating rheumatoid arthritis.<sup>722</sup> But natural resources were not the only reason that India’s medical technology grew so successfully: the nation also possessed many minerals, alloys, and even fresh water. It was critical for anyone working within a laboratory to have perfectly shaped glass, which required tons of sand in order to manufacture it. This was also used in creating blood collection bottles and for the distribution of other vaccinations. The abundance of both sand and water were evident throughout India in the 1960s and ‘70s and allowed the accelerated growth of medical technology. Without these abundant natural resources, India’s medical technology could never have come into existence.

Another reason for medical technology development in India through the 1970s and 1980s was the inward flow of foreign and domestic investment.<sup>723</sup> Investment grew during the last half of the 1970s and through the 1980s by roughly 300 per cent, or 3 fold by comparison to the previous decade.<sup>724</sup> With a baseline of approximately \$45 million USD in 1970, India’s level of foreign direct investment rose and fell through the period from 1973 to 1984.<sup>725</sup> The high point came in 1981, when foreign direct investment peaked at \$92 million USD.

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<sup>720</sup> M. Banerjee, *Power, Knowledge, Medicine: Ayurvedic Pharmaceuticals at Home and in the World* (New Delhi, 2009); M. Bode, *Taking Traditional Knowledge to the Market: The Modern Image of Ayurvedic and Unani Industry, 1980-2000* (Hyderabad, 2008).

<sup>721</sup> B. Bart, ‘Boom is Sparked by Exotic Plants’, *New York Times*, 28 February 1960, p. 1.

<sup>722</sup> *ibid.*

<sup>723</sup> P.B. Prime, V. Subrahmanyam, and C.M. Lin, ‘Competitiveness in India and China: The FDI Puzzle’, *Asia Pacific Business Review*, (18) 3 (2012), p. 309.

<sup>724</sup> Ahmad, *Technological Development in Drugs & Pharmaceutical Industry in India*.

<sup>725</sup> *ibid.*

India also pursued the strategy of exporting drugs despite the commonly held notion that exports would hurt the self-sustained medical technology industry. In 1973, Karl Helleiner presented a paper at the University of Oxford that scrutinized the concept of manufacturing for exports.<sup>726</sup> The paper detailed how manufacturing exports were expected to create new areas of development in resource-constrained countries over the second half of the twentieth century. Helleiner discussed how any sort of ‘outward orientation’ – of whatever character – was prejudicial to independent and self-sustaining development.<sup>727</sup> However, this was not the case for India, which went from being an exporter to an inventor in future periods. Although it was largely excluded from trading with the West, India’s trade with the Soviet Bloc was booming. The low-cost method of doing business resulting from the Patents Act of 1970 would soon give India a competitive edge with other developing nations in an increasingly global health market. Reduced prices for these technologies made them affordable for individuals, institutions, and governments around the world.

During this time, India also signed trade agreements with many other countries, developed and non-aligned. For example, in October 1973, West Germany signed a trade agreement with India to increase its trade in the area of drugs and pharmaceuticals.<sup>728</sup> The movement toward marketing its medical technology production to non-aligned countries was given a massive boost in September 1976, when India attended an international meeting of Commonwealth countries at the Colombo Summit.<sup>729</sup> Dozens of non-aligned countries from around the world initiated a new regional cooperative aimed at ending dependence on

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<sup>726</sup> G.K. Helleiner, ‘Manufacturing For Export, Multinational Firms and Economic Development’, *World Development*, 1 (7) (1973), p. 1.

<sup>727</sup> *ibid.*, p. 17.

<sup>728</sup> ‘India, GDR Sign Trade Tie-up Period’, *Times of India*, 18 October 1973, p. 5.

<sup>729</sup> S.A. Kochanek, ‘India's Changing Role in the United Nations’, *Pacific Affairs* (1980), p. 48.

multinational medical technology corporations.<sup>730</sup> The result was massive growth for India's domestic pharmaceutical, drug, and medical sectors in the late-1970s and early-1980s. In addition, many scientific communities in the United States continued to work with India and develop various medicines, devices, and medical supplies during these years. The strong relations were probably due to an imbalance in currency ratios, and the desire to improve the scientific transfer between the two countries and enlist Indian scientists in US research projects.<sup>731</sup> Although the nations' military strategies were at odds, the scientific communities continued to work collaboratively.<sup>732</sup>

Another crucial event that helped to spur the medical technology and related industries during this period was a 1981 loan from the IMF to help India recover from yet another economic crisis.<sup>733</sup> The Indo-Pakistan war, the influx of nearly ten million refugees from East Pakistan, the end of American economic aid, a severe drought, and the oil crisis of the 1970s all contributed to an unprecedented strain on India's economy.<sup>734</sup> Despite India possessing a \$2 billion USD loan from the World Bank, the economic difficulties caused a short-fall in national reserves and the balance of payments crisis of 1981.<sup>735</sup> Therefore, India negotiated an unprecedented loan from the IMF in 1981 to rescue its financial system.

One of the conditions of the IMF payment was the liberalization of many of India's trade policies. With these measures in place, the economic growth rates more than doubled. In the

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<sup>730</sup> 'Third World to End Drug Monopoly', *Times of India*, 13 September 1976, p. 9.

<sup>731</sup> D. Binder, 'Foreign Currency Aids US Science', *New York Times*, 30 December 1973, A1.

<sup>732</sup> Proceedings from Grand Jury Testimony of Richard M. Nixon 24 June 1975. Hoover Reporting Co., Inc. San Clemente, CA, (1975), p. 269, Nixon Presidential Library.

<sup>733</sup> R.B. Nayar, 'Globalisation and India's National Autonomy', *Commonwealth and Comparative Politics* 41.2 (2003), p. 11.

<sup>734</sup> *ibid*, p. 12.

<sup>735</sup> J.M. Boughton, 'Silent Revolution: The International Monetary Fund, 1979-89', *International Monetary Fund* (2001), p. 709.

period from 1952–79, India saw a 1.57 per cent average growth rate.<sup>736</sup> Following the IMF payment, India was able to reinvest and shift its economy to a faster growth supply side approach, where it began creating more goods and services and selling them abroad. This led to a post-IMF crisis growth rate of 3.56 per cent during the years 1980–2005.<sup>737</sup> This infusion of IMF money helped stabilize the economy, and thus provided an environment for the medical technology industry to continue to enjoy unprecedented growth.

Finally, newspapers around the world published regular articles on the exploitation of Third World countries by Western medical technology companies, which helped to skew public opinion toward India's medical products. For example, a November 1976 article in the *New York Times* entitled 'Drug Marketers Stir Bitter Debate in Brazil' stated that drug companies were 'marking up their drugs by an average of 155 per cent compared with prices of the same medicines on the international market.'<sup>738</sup> The article went on to state that India really only needed 116 drugs of the 15,000 or so products that were being marketed at that time in that country.<sup>739</sup> Furthermore, in December 1982, the *Times of India* quoted Oxfam International as calling the multinational medical technology companies irresponsible.<sup>740</sup> Such articles were not uncommon in this period, and caused many people to take pause over the prices they were paying for their medicines, medical devices, and supplies.

Due to the above factors, medical technology in India prospered during this time. In 1952 there were 1,752 pharmaceutical and medical technology communities in India; by 1970, there were 2,257, and by 1984, that number had grown to around 10,000.<sup>741</sup> In his book *Technological*

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<sup>736</sup> K.S. Nell, 'An Alternative Explanation of India's Growth Transition: A Demand-Side Hypothesis', *Cambridge Journal of Economics* (37) 29 (2012), p. 113.

<sup>737</sup> *ibid.*

<sup>738</sup> J. Kandell, 'Drug Marketers Stir Bitter Debate in Brazil', *Times of India*, 14 November 1976, p. 3.

<sup>739</sup> *ibid.*

<sup>740</sup> 'Giant Drug Companies Exploiting Third World', *Times of India*, 13 December 1982, p. 15.

<sup>741</sup> Ramani, 'Rising to the Technological Challenge', p. 98.

*Development in Drugs & Pharmaceutical Industry in India*, Husain Ahmad collected statistics from the government of India's office of pharmaceuticals and therapeutics management and determined that from 1978–81, the number of research and development staff rapidly increased in companies of all sizes. He studied 81 local pharmaceutical technology companies with the sales stratified by seven different categories, and looked at the research and development personnel in each of these companies.<sup>742</sup> Across the board, research and development personnel increased in companies at the higher end of the scale by roughly 10 per cent each year.<sup>743</sup> This indicates that the indigenous pharmaceutical industry was growing in terms of its production and research and development.

Following the testing of its first nuclear warhead on May 18, 1974 at the Pokhran testing range, medical technology now moved a step closer to self-sufficiency in the area of nuclear medicine. With unlimited access to nuclear fuel, the Indian medical technology industry could now manufacture X-ray machines in a way unimaginable a year earlier. The development of these medical devices was critical to India's overarching medical diagnostic procedures throughout the country. As described earlier, X-ray machines were extremely difficult to maintain because most of the raw supplies and materials were unavailable in India. The ability to manufacture large numbers of these machines using native nuclear material created a massive medical device marketplace across the subcontinent. Thus, whilst most of the world regarded the Pokhran test as a destabilizing factor in global peace, the medical technology industry saw it as a method to enhance the medical device manufacturing element within India's medical technology industry.

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<sup>742</sup> Ahmad, *Technological Development*, p. 76.

<sup>743</sup> *ibid.*

## II. Regulatory Principle Meets International Law

This section shows how India's new regulations helped spur the nation's inclusion in the global medical technology complex. It will cover a number of factors that were critical for the development and growth of India's medical technology complex during the 1970s. First, India had a mostly unrestricted or free labour market, which allowed for the large scale, cost-efficient manufacturing of devices, pills, and supplies across a sector that, in other parts of the world, traditionally had high labour costs. Another key element that added to the rapid growth of medical technology was India's policy making. A third key element that helped growth in the 1970s was a policy that allowed foreign governments to invest directly in Indian medical technology companies. Although some saw this policy as almost antithetical to the Patents Act of 1970, which effectively disavowed international property law, there were many investors willing to invest in a secondary market that was feeding cheap medicines to much of the world's emerging market. The last factor was the rise to power of the Janata Party in the mid-1970s, and especially their policy of requiring foreign multinational corporations to jointly venture with Indian corporations whilst doing business in India. These four key factors accelerated the growth of medical technology in India in the 1970s.

The Patents Act of 1970 was a major force in Indian growth. First, it allowed the replication of molecular entities if there was a varied manufacturing process. As noted in Chapter 5, the Patents Act of 1970 'changed the laws governing drug patents, applying the laws not to the chemical compounds themselves but to the processes used to manufacture them.'<sup>744</sup> Therefore, Indian pharmaceutical companies could produce drugs if the manufacturing process differed from the original patent holders' process. Indian researchers thus focused on reverse engineering,

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<sup>744</sup>G.T Haley & U.C.V. Haley, 'The Effects of Patent-Law Changes on Innovation: The Case of India's Pharmaceutical Industry', *Technological Forecasting & Social Change* 79 (2012), p. 608.

i.e. finding new processes to produce already established drugs, instead of developing new drugs. Reverse engineering is more cost effective than developing new drugs, since reverse engineered products could be developed cheaper than the original innovators. This enabled India to develop an industry comprised of 45 per cent bulk pharmaceuticals and 55 per cent formulations. The Act also shortened patent time frames by providing ‘seven-year process patents from application time, or five-year process patents from sealing time (the date for the official granting of the patent), whichever was shorter.’<sup>745</sup> Finally, the Act gave the Indian Patent Office the ability to require patent holders to license the processes or adjust license fees charged by patent holders.<sup>746</sup> The international community took a closer look at financing opportunities in India once the after-effects of the Patents Act of 1970 were better known, and the investment dollars began to flow into India.<sup>747</sup>

Rallis India was a chemical and pharmaceutical company founded in colonial India in the nineteenth century.<sup>748</sup> It benefitted tremendously from the revision of the Patents Act in 1970, with a 30 per cent increase in sales in 1971–2.<sup>749</sup> Rallis was diversifying internationally primarily because its operating profits remained relatively low as a result of price restrictions in India. The Drugs Price Control Order of 1970 was a government mechanism that dictated the prices medical technology companies could charge within the India marketplace. Thus, whilst the domestic drug market provided a solid market for Indian pharmaceutical companies, price restrictions limited the profits of pharmaceutical companies. In a January 1973 article, J.D. Choksi, Rallis’s chairman, stated that the growth of the company depended upon international development. Rallis’s strategy of bringing low-cost products to an international market seemed the best method

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<sup>745</sup> *ibid.*, pp. 612–3.

<sup>746</sup> *ibid.*, pp. 608–9.

<sup>747</sup> Prime, ‘Competitiveness in India and China: The FDI Puzzle’, p. 309.

<sup>748</sup> Rallis India Limited. Accessed at [www.rallis.co.in/aboutus/history.asp](http://www.rallis.co.in/aboutus/history.asp).

<sup>749</sup> *ibid.*

to combine the high growth and low margins in the domestic Indian market with the higher profit margins they could find in the international market.

Furthermore, since India had a mostly unrestricted or free labour market, it managed to keep labour costs low. Although India had laws to regulate the labour market, employers were learning to bypass them. For example, the Contract Labour (Regulation and Abolition) Act of 1970 (CLA) gave the government the power to decide which areas of work engagement of contract labour, as opposed to permanent labour, would be permitted.<sup>750</sup> This regulation made ‘company labour processes still more rigid and the employers even more desperate to break the shackles of the law in order to survive’.<sup>751</sup> Employers found ways to bypass the regulations by shifting India’s workforce from more costly permanent labourers towards underpaid unregulated casual and contract labourers. Cheaper labour resulted in lower costs of manufacturing and lower prices. In addition, India declined to implement the kind of anti-poverty policies that some European nations had recently adopted. France, for example, developed a minimum income scheme called *Revenue Minimum d’Insertion* in 1988, and other countries like Spain, Portugal, and Italy soon followed.<sup>752</sup>

India’s growing labour market also helped attract foreign investment, which had an impact on the global medical technology complex. By 1981, India’s population had reached a staggering 683 million, a growth rate of 2.5 per cent; the nation had thus added 135 million new citizens in just one decade.<sup>753</sup> Two consecutive decades of 2.5 per cent compounded population

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<sup>750</sup> A.K.S. Gupta and P.K. Sett, ‘Industrial Relations Law, Employment Security and Collective Bargaining in India: Myths, Realities and Hopes’, *Industrial Relations Journal*, 31.2 (2000), pp. 147–8.

<sup>751</sup> *ibid.*, p. 148.

<sup>752</sup> M. Matsaganis, et al. ‘Mending Nets in the South: Anti-poverty Policies in Greece, Italy, Portugal, and Spain’, *Social Policy & Administration*, 37.6 (2003), p. 643.

<sup>753</sup> R. Tirthankar, *The Economic History of India: 1857–1947* (New Delhi, 2000), p. 270.

growth meant that India had a growing workforce. This workforce was also technically skilled and English-speaking, which was highly attractive to multinational companies.<sup>754</sup>

During these years, the medical technology industry's influence on policymaking within the government was growing. This contrasted with the situation two decades earlier, when the government issued import policies that decreased the growth rate of medical technology.<sup>755</sup> In a news conference on January 4, 1973, the Union Minister for petroleum and chemical products, H.R. Gokhale, assured drug companies that the government would not implement any state policies that would cause difficulties for the industry.<sup>756</sup> He was accompanied by the Health Minister for Maharashtra, Dr. Rafiq Zakaria, who also assured those present that the government's pressure to reduce drug prices would end so that domestic drug companies could continue to export their manufactured products.<sup>757</sup>

India's new policy regarding foreign ownership of Indian companies was another factor in the growth of the medical technology complex. One of the early results of the Patents Act of 1970 was the withdrawal of foreign direct investment by multinational corporations.<sup>758</sup> In fact, foreign direct investment dropped from \$48 million USD in 1971 to \$18 USD million a year later.<sup>759</sup> Such a steep decline in off-shore investment dollars was alarming to the Indian government, so on February 3, 1973, they announced a new policy allowing foreign-majority firms to have a controlling stake of ownership in certain indigenous Indian companies, including ceramics, plate glass, and cement.<sup>760</sup> More importantly, the policy stated that international corporations with interests in 'drugs and pharmaceuticals, scientific instruments and a very wide

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<sup>754</sup> Haley, 'The Effects of Patent-Law Changes on Innovation', p. 613.

<sup>755</sup> Letter from Office of the High Commissioner for India, Commerce Department, India Supply Commission, London, 21 March 1949.

<sup>756</sup> 'Rallis India Poised for Development', *Times of India*, 19 January 1973, p. 4.

<sup>757</sup> 'Gokhale's Assurance to Pharmaceutical Units', *Times of India*, 5 January 1973, p. 3.

<sup>758</sup> Prime, 'Competitiveness in India and China: The FDI puzzle', p. 309.

<sup>759</sup> *ibid.*

<sup>760</sup> "'More Elbow Room for Large Units' Growth', *Times of India*, 3 February 1973, p. 1.

range of chemicals' would be permitted to invest heavily in these new areas.<sup>761</sup> Thus, the Indian government once again proved its agility when it came to attempting to maintain growth in its industrial sectors. The policy clearly worked, as foreign direct investment rose over the next three years by nearly 50 per cent each year, to \$38 million USD in 1973, \$57 million USD in 1974, and \$85 million USD in 1975.<sup>762</sup>

Though the drug industry was seeing rampant growth, many decried the fact that most Indians still lacked access to many critical medicines.<sup>763</sup> This resulted in the formation of the Hathi Committee, which delivered one of the key reports on medical technology in post-colonial India in 1975.<sup>764</sup> A continuation of the Patents Act's attempt to increase the accessibility of medicines to the common Indian, the Hathi committee report had three key objectives. The first was to provide a pathway for the country to be self-sufficient in drugs; second, for the country to be free from foreign corporate 'exploitation'; and finally, to provide access to more medications for people across India. The report provided detailed accounts of tonnage produced for dozens of different drugs, as well as providing the sales of numerous multinational corporations.<sup>765</sup>

The Hathi committee largely consisted of high level officials from government and academia.<sup>766</sup> The data collection efforts were impressive in their scope, including dozens of site visits to manufacturing plants and governmental agencies, as well as qualitative surveys written for several different interviewee types.<sup>767</sup> Ultimately, its summary recommendations put forward a number of new policy moves. Additionally, a small group within the committee wanted to nationalize the assets of the multinational pharmaceutical companies; although this plan was

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<sup>761</sup> *ibid.*

<sup>762</sup> Eren-Vural, 'Domestic Contours of Global Regulation', p. 115.

<sup>763</sup> Hathi Committee Report. Accessed at

[www.communityhealth.in/~commun26/wiki/index.php?title=File:Hathi\\_Committee\\_report\\_1975.PDF.pdf](http://www.communityhealth.in/~commun26/wiki/index.php?title=File:Hathi_Committee_report_1975.PDF.pdf), p. 19.

<sup>764</sup> P.K. Sarkar, 'A Rational Drug Policy,' *Indian Journal of Medical Ethics* 1 (11-2) (2004), p. 11.

<sup>765</sup> Hathi Committee Report, p. 61.

<sup>766</sup> *ibid.*, p. 6.

<sup>767</sup> *ibid.*, p.12.

never implemented, it was supported by a majority of the committee, according to a May 1977 note written to Prime Minister Desai by one of the committee members, R.S. Ramachandran.<sup>768</sup> A former leader of the Drugs Control office in the Indian Health Service, Ramachandran stated he believed that the nationalization of foreign national drug firms was needed and expressed his frustration that the Prime Minister's administration was 'dragging their feet' on this matter.<sup>769</sup> However, a takeover of foreign national drug firms would also most likely have served as a barrier for future investments in the subcontinent, for fear of any future nationalization that might take place. In the end, the Hathi report resulted in little real change with regards to India's access to medicines, but it did culminate in India's first national drug policy in 1978. The policy contained many original ideas, such as prohibiting brand name drugs, improving research funding, and nationalizing international drug company assets, but many of these failed to become law, including the last one.<sup>770</sup>

Furthermore, countries like the United States were continuing to invest in India. In 1977, John Sherman Cooper, a partner at the Washington D.C.-based law firm Covington Burling, sent a letter to Prime Minister Desai thanking him for a recent meeting between Covington Burling and another law firm colleague in Delhi: 'American companies believe that in the early days of the development of the form so what industry in India they made a substantial contribution. It is there objective to continue contributing to India drug objectives, if they can do so and maintain a stable economic base in India.'<sup>771</sup> The letter went on to discuss how best to engage the Prime Minister's office or another 'appropriate ministry' in order to be of continued assistance. Cooper requested an additional meeting to continue the conversation about opportunities for American

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<sup>768</sup> *ibid.*, p. 97.

<sup>769</sup> Letter from Shri P.S. Ramachandran to Prime Minister Desai, File No. 17-1315-1977 NAI.

<sup>770</sup> P.K. Sarkar, 'A Rational Drug Policy', *Indian Journal of Medical Ethics* (2004), pp. 11–12.

<sup>771</sup> Covington & Burling Letter to Prime Minister, File No. 17-1315-1977 PMS, NAI.

companies to assist in the development of the pharmaceutical industry in India. Cooper also referred to the presence of the U.S. Ambassador to India, Robert Goheen, noting, ‘It was good to see you again, in full vigor, as I have recalled many times our meetings in Washington and India.’<sup>772</sup> This letter, from a leading American law firm written on behalf of a spokesperson for the American pharmaceuticals industry, serves to underline the transformation of India’s medical technology industry from a small provider to global player.

Prime Minister Desai’s meetings were a part of a broader political calculation, as the centrist Janata Party worked to ensure that the medical complex would continue its strong growth. In April 1977, the country rejected the liberal Congress Party, which had ruled over the past ten years, for the Janata Party, which subsequently enacted a less restrictive import policy for the large equipment needed to produce greater numbers of medicines and vaccinations.<sup>773</sup> In March 1982, Janata enacted the Drugs and Cosmetics Act, which was intended to ensure that drug and device sectors in the country were producing high-quality products.<sup>774</sup> Commerce Minister Mohan Dharia stated in a radio address that the list of free import items – that is, items upon which there would be no import tax – would include drugs and medicines and technical and scientific books.<sup>775</sup>

The ability to adapt its policy in response to quickly changing circumstances was certainly not new to India, but it was now being practiced on a regular basis within the medical technology community. It was one of many factors that allowed India’s medical technology industry to continue to flourish not only domestically, but internationally as well. Another will be considered in the following section.

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<sup>772</sup> *ibid.*

<sup>773</sup> ‘India Liberalizes Imports Policy in an Effort to Spur Protection’, *New York Times*, 28 April 1977, p. 93.

<sup>774</sup> ‘Drug Act to be Amended Soon’, *Times of India*, 30 March 1982, p. 15.

<sup>775</sup> *ibid.*

### III. Education Moves Closer to Medicine

Between 1973 and 1984, the educational system within India developed the capacity to train professionals in medical technology; indeed, such was the nation's proficiency in medical education that its educational system proliferated and expanded beyond its borders, with many Indians finding work in other countries.<sup>776</sup> The boom in medical technology manufacturing led by the life sciences, medical devices, and medical supply manufacturing companies also created a demand for a labour market skilled in areas of medical technology and areas of science related to medical technology. Indians were increasingly inclined to earn degrees in medical technology because such qualifications provided jobs. This trend marked the beginning of growth in the medical, biomedical, biotechnical, and corresponding informatics training in the 1970s.

Historically, education in India was only made available to the Brahmin, the highest caste group made up of scholars, philosophers, priests, and religious leaders.<sup>777</sup> Education was also restricted to the privileged classes under British colonial rule from the 1700s to 1947. After independence, there were large investments in the public sector of medical education. In the 1970s, the government was unable to prioritize education in the fifth five-year plan, so the private sector saw a profitable business opportunity to provide access to medical education to growing population of India.<sup>778</sup> Even though the number of medical education institutions in the public sector 'grew by only 36 per cent (seats grew by 20 per cent) in the period from 1970 to 2004,' there was a 900 per cent increase in private medical education institutions from 1970–

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<sup>776</sup> J.B.G. Tilak, 'Emerging Trends and Evolving Public Policies in India', *Private Prometheus: Private Higher Education and Development in the 21st Century* (London, 1999), p. 129.

<sup>777</sup> G. Rhines, Cheney, B. Brown Ruzzi, and K. Muralidharan, 'A Profile of the Indian Education System', Prepared for the New Commission on the Skills of the American Workforce, November 2005. Accessed 14 July 2014 at [www.skillscommission.org/study.htm](http://www.skillscommission.org/study.htm).

<sup>778</sup> India's Planning Commission, Fifth Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

2004. The increase in institutions made education, specifically higher specialized education, accessible to more Indians.

Year	Enrolment capacity		Total	Institutions		Total
	Public	Private		Public	Private	
1950						
Number	4175	60	4235	27	1	28
Share (%)	98.6	1.4	100.0	96.4	3.6	100.0
1950						
Number	7725	610	8335	56	4	60
Share (%)	92.7	7.3	100.0	93.3	6.7	100.0
1970						
Number	10 925	1350	12 275	89	10	99
Share (%)	89.0	11.0	100.0	89.9	10.1	100.0
1980						
Number	11 425	1820	13 245	96	14	110
Share (%)	86.3	13.7	100.0	87.3	12.7	100.0
1990						
Number	11 800	4785	16 585	102	41	143
Share (%)	71.1	28.9	100.0	71.3	28.7	100.0
2000						
Number	12 720	6635	19 355	115	61	176
Share (%)	65.7	34.3	100.0	65.3	34.7	100.0
2004						
Number	13 320	10 685	24 005	121	100	221
Share (%)	55.5	44.5	100.0	54.8	45.2	100.0

Table 14: Trends in medical education, 1950–2004<sup>779</sup>

As medical education institutions began to grow, India also established institutions to train medical teachers. In 1974, National Teachers Training Centres (NTTCs) were established in four premier institutions.<sup>780</sup> At the NTTCs medical teachers were trained in educational science and technology, as well as how to develop and apply a systematic educational process. The programmes at the NTTCs involved ‘a 10-day interactive workshop covering topics such as educational objectives, educational methods, media, assessment methods and curriculum planning.’<sup>781</sup> Furthermore, the participants selected to attend NTTCs were expected to start medical education activities when they returned to the institutes where they taught permanently.

<sup>779</sup> *ibid.*, p. 1011.

<sup>780</sup> P. Bansal and A. Supe, ‘Training of Medical Teachers in India: Need for Change’, *Indian Journal of Medical Sciences*, 61 (2007), p. 480.

<sup>781</sup> *ibid.*

Despite the advancements, the educational system in India during this period still suffered from a significant degree of inequity. The growth of medical education occurred ‘mainly in the richer and healthier Indian provinces.’<sup>782</sup> Some areas of the country had very high levels of education, whilst others lagged far behind their countrymen. In a detailed analysis of the country’s educational opportunities, Niaz Asadullah provided a detailed critique of India’s educational disparity, showing that states like Bihar had a population with a secondary education completion rate of 7 per cent and a primary education rate of 21 per cent, which compared to Delhi at 40 and 62 per cent, respectively.<sup>783</sup> Especially poor was Barmer, a district in Rajasthan with a literacy rate of only 8 per cent. The worst national literacy rate in the world, by comparison, is Burkina Faso, a sub-Saharan country with 10 per cent literacy.<sup>784</sup>

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<sup>782</sup> Mahal, ‘Growth of Private Medical Education in India’, p. 1010. Healthier states have a life expectancy at birth of 65.5 years. The other states have a life expectancy at birth of 59.4 years. *ibid.*

<sup>783</sup> M.N. Asadullah and G. Yalonetzky, ‘Inequality of Educational Opportunity in India: Changes Over Time and Across States’, *World Development*, (40) 6 (2012), p. 1156.

<sup>784</sup> B. Chandra, M. Mukherjee, and A. Mukherjee, *India Since Independence* (New York, 2008), p. 651.

States of India	2006						Admissions per year	Population	Admissions per 1,000 population
	1965	1980	1990	Total	Private	Gov't			
Andhra Pradesh	8	9	10	31	20	11	3,825	75,727,541	0.05
Assam	3	3	3	3	0	3	391	26,638,407	0.015
Bihar	2	6	8	8	2	6	510	82,878,796	0.006
Chandigarh	0	0	0	1	0	1	50	900,514	0.055
Chattisgarh	1	1	1	3	0	3	250	20,795,956	0.012
Delhi	3	4	4	5	0	5	560	13,782,976	0.041
Goa	1	1	1	1	0	1	100	1,343,998	0.074
Gujarat	4	4	7	12	4	8	1,655	50,596,992	0.033
Haryana	1	1	1	3	2	1	350	21,082,589	0.017
Himachal P	0	1	1	2	0	2	115	6,077,248	0.019
Jammu and Kashmir	1	2	3	4	2	2	350	10,069,917	0.035
Jharkhand	2	3	3	3	0	3	190	26,909,428	0.007
Karnataka	10	16	19	35	29	6	3,385	52,733,558	0.064
Kerala	4	4	5	17	12	5	1,850	31,838,619	0.058
Madhya P	5	5	5	8	3	5	970	60,385,118	0.016
Maharashtra	10	12	28	39	20	19	4,085	96,752,247	0.042
Manipur	0	1	1	1	1	0	100	2,388,634	0.042
Orissa	3	3	3	4	1	3	464	36,706,520	0.013
Pondicherry	1	1	1	7	6	1	775	973,829	0.796
Punjab	4	5	5	7	4	3	670	24,289,296	0.028
Rajasthan	5	5	5	8	2	6	850	56,473,122	0.015
Sikkim	0	0	0	1	0	1	50	540,493	0.093
Tamilnadu	7	9	13	25	10	15	2,865	62,110,839	0.046
Tripura	0	0	0	2	1	1	200	3,191,168	0.063
Uttar Pradesh	6	9	9	16	6	10	1,662	166,052,859	0.010
Uttaranchal	0	0	0	3	3	0	300	8,479,562	0.035
West Bengal	5	7	7	9	0	9	1,105	80,221,171	0.014
Total	86	112	143	258	137	115	27,677	1,019,942,997	
Median									0.035

\* Twoschools that are "not permitted" (i.e., not approved) but listed on the MCI Web site are omitted from this table.

Table 15: Growth of Indian Medical Schools by State, 1965–2006<sup>785</sup>

#### IV. The World Joins to Eliminate Smallpox

Smallpox was, until recently, one of the most feared infectious diseases in the world.<sup>786</sup> It is a highly virulent, contagious, and easily transmittable disease. Approximately 300 million people died of smallpox during the twentieth century, more than double the death toll of all the military conflicts of that century.<sup>787</sup> In 1967, the disease still threatened 60 per cent of the world's

<sup>785</sup> A. Supe and W.P. Burdick, 'Challenges and Issues in Medical Education in India', *Academic Medicine*, 81 (12) (2006), p. 1078.

<sup>786</sup> D.A. Henderson, 'The Eradication of Smallpox – An Overview of the Past, Present, and Future', *Vaccine* (29S) (2011), pp. D7–D9.

<sup>787</sup> *ibid.*, p. D8.

population.<sup>788</sup> Smallpox is transmitted during close contact with infected symptomatic people; in fact, when the virus becomes airborne, anyone close enough to inhale it can be infected.<sup>789</sup>

The disease caused extraordinary physical disfigurement and pain, with a mortality rate reaching 50 per cent.<sup>790</sup> Many of the cultures in India and other equatorial nations attributed smallpox to gods or goddesses, and various deities were created especially for this virus.<sup>791</sup> The following description of people infected with smallpox speaks for itself:

Smallpox was hideous and unforgettable. For me, the memory of a ward full of smallpox victims thirty-five years ago in Dhaka, Bangladesh, is still vividly etched in my mind: anxious, pleading, pock-deformed faces. The ugly, penetrating odour of decaying flesh that hung over the ward; the hands, covered with pustules, reaching out, as people begged for help. Neither water nor food offered comfort; pus-filled lesions covered the inside of their mouths, making it painful for them to even chew or swallow. Flies were everywhere, thickly clustered over eyes half-closed by the pustules. More than half the patients were dying, and there was no drug, no treatment that we could give to help them.<sup>792</sup>

Vaccination was the main weapon in the battle against smallpox. Vaccination developed from variolation, which is an 'ancient Asian technique of infecting a non-immune patient with fluid from a smallpox pustule.'<sup>793</sup> The smallpox vaccine was introduced and developed in 1796 by Dr. Edward Jenner, who noticed that people who had recovered from a cowpox infection, a virus which causes pustules on the skin of people who deal with cows, were immune to

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<sup>788</sup> World Health Organization Media Centre, Anniversary of Smallpox Eradication Podcast Transcript, Veronica Riemer. Accessed 14 July 2014 at [www.who.int/mediacentre/multimedia/podcasts/2010/smallpox\\_20100618/en/](http://www.who.int/mediacentre/multimedia/podcasts/2010/smallpox_20100618/en/).

<sup>789</sup> D.A. Henderson, *Smallpox: The Death of a Disease: The Inside Story of Eradicating a Worldwide Killer* (Amherst, 2009), p. 33.

<sup>790</sup> Q. Fang, 'Host Range, Growth Property, and Virulence of the Smallpox Vaccine: Vaccines Virus Tian Tan Strain', *Virology* (335) 2 (2005), pp. 242–51.

<sup>791</sup> Henderson, 'The Eradication of Smallpox.'

<sup>792</sup> Henderson, *Smallpox*, p. 31.

<sup>793</sup> Stewart, 'The History of the Smallpox Vaccine', p. 329.

smallpox.<sup>794</sup> However, the original vaccine was liquid in form and required refrigeration to retain its potency for more than a few days. Throughout the twentieth century, spent enormous amounts of money to find a vaccine for the smallpox virus that could be transported and stored without refrigeration.<sup>795</sup> The development of such a vaccination in 1951 was an extraordinary event in medical history: mass production of the vaccine fuelled the notion that smallpox could be eradicated.<sup>796</sup> The freeze-dried vaccine remained potent for over a month, even in very warm temperatures, and was the main form used after 1967.<sup>797</sup>

Whilst smallpox had long been eradicated from most developed nations, the Indian subcontinent was seen as a ‘major global public health threat’, especially as travel between continents was becoming easier.<sup>798</sup> The devastation caused by smallpox led many nations to get together and form a plan to eradicate the disease. In 1966, the Nineteenth World Health Assembly voted to allocate \$2.4 USD million from the WHO budget for smallpox eradication, resulting in the ‘Intensified Smallpox Eradication Programme’, which was launched a year later.<sup>799</sup> Dr. Donald A. Henderson was appointed director of the programme from 1966 to 1977, one of the goals of which was mass vaccination in order to prevent infection and lessen the severity of infection.<sup>800</sup> Critical to this goal was a sufficient supply of vaccines. The eradication programme increased the volume of vaccines and included donations from Jordan, Madagascar, Mexico, the Netherlands, the Philippines, Switzerland, Thailand, the USSR and the United

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<sup>794</sup> F. Fenner, D.A. Henderson, I. Arita, Z. Jezek, and I.D. Ladnyi, ‘Smallpox Vaccine and Vaccination in the Intensified Smallpox Eradication Programme’, *Smallpox and its Eradication* (1988), p. 540; Henderson, *Smallpox*, p. 35.

<sup>795</sup> L.H. Collier, ‘The Development of a Stable Smallpox Vaccine’, *Journal of Hygiene*, 53 (01) (1955), p. 76.

<sup>796</sup> *ibid.*

<sup>797</sup> Fenner, ‘Smallpox Vaccine and Vaccination’, p. 540.

<sup>798</sup> S. Bhattacharya, *Expunging Variola: The Control and Eradication of Smallpox in India* (Hyderabad, 2006), p. 63.

<sup>799</sup> Fenner, ‘Smallpox Vaccine and Vaccination’, p. 541.

<sup>800</sup> World Health Organization. Accessed 14 July 2014 at [www.who.int/csr/disease/smallpox/en/](http://www.who.int/csr/disease/smallpox/en/).

Kingdom.<sup>801</sup> Another goal of the programme was to start controlling outbreaks, which entailed the surveillance and containment of smallpox cases.<sup>802</sup>

Year	Doses of vaccine (thousands)		
	Received	Distributed	Balance at end of year
1958	25 000	0	0
1959	0	0	0
1960	5 000	3 355	0
1961	2 000	7 420	0
1962	0	9 390	0
1963	98	7 528	0
1964	9 519	13 465	0
1965	1 637	1 897	0
1966	3 808	3 808	0
1967	15 820	14 807	1 208
1968	24 949	21 316	4 842
1969	21 370	20 686	5 526
1970	29 264	32 234	2 557
1971	51 544	44 741	9 360
1972	44 816	44 593	9 683
1973	52 023	34 676	26 930
1974	40 436	44 802	22 561
1975	33 841	36 310	20 092
1976	38 456	21 822	36 727
1977	6 408	23 657	18 935
1978	9 958	16 308	13 085
1979	35 090	4 940	43 235

Table 16: Quantities of smallpox vaccine<sup>803</sup>

The programme required cooperation from many countries, including the United States and the Soviet Union.<sup>804</sup> Both countries cooperated and donated to the programme; in fact, the USSR's desire to spread communism made it one of the programme's largest vaccine donors. Whereas most European nations had one laboratory working to produce vaccines, the USSR had six. Of the 47,062,500 million doses of vaccine donated to WHO from 1958–66, 25 million were donated by the USSR alone. All vaccines were tested for quality by a laboratory in the

<sup>801</sup> Fenner, 'Smallpox Vaccine and Vaccination', p. 542.

<sup>802</sup> World Health Organization, Bulletin, Smallpox: dispelling the myths. An interview with Donald Henderson. Accessed 24 July 2014 at [www.who.int/bulletin/volumes/86/12/08-041208/en/](http://www.who.int/bulletin/volumes/86/12/08-041208/en/).

<sup>803</sup> Fenner, 'Smallpox Vaccine and Vaccination', p. 542.

<sup>804</sup> Henderson, 'The Eradication of Smallpox', p. D8.

Netherlands, which showed that Indian-produced vaccines met international standards for purity, potency, and stability.<sup>805</sup>

**TABLE 1**  
**COMPARISON OF SUCCESSFUL TAKE RATES FOR BIFURCATED NEEDLE AND ROTARY LANCET TECHNIQUES IN REVACCINEES APPLIED TO THE SAME PERSONS <sup>a</sup>**

Group	Titre of vaccine (pock-forming units/ml)	Technique employed	Total no. of revaccinations	No. of persons showing successful takes	Percentage of successful takes
A	1 × 10 <sup>8</sup>	Rotary lancet	84	22	26.2
		Bifurcated needle	84	47	56.0
B	5 × 10 <sup>7</sup>	Rotary lancet	82	10	12.2
		Bifurcated needle	82	29	35.4
C	1 × 10 <sup>7</sup>	Rotary lancet	81	10	12.3
		Bifurcated needle	81	26	32.1

<sup>a</sup> Single insertion by each technique.

Table 17: Bifurcated Needle v. Rotary Lancet<sup>806</sup>

The discovery of the bifurcated needle or multiple puncture vaccination was also an important factor to the programme's success. The bifurcated needle – a pronged needle that 'would retain the capillary activity of a loop and that it might have simultaneous utility in scarification' – was developed in 1961 at Wyeth Laboratories by B.A. Rubin.<sup>807</sup> In 1968, Wyeth Laboratories waived its patent and allowed the WHO to use the needle for the smallpox programme. The bifurcated needle provided cost savings and could be used by anyone after minimal training.<sup>808</sup> The ease of use and the lack of lesions left by the vaccine also helped to win

<sup>805</sup> Interview with D.A. Henderson, 9 October 2013.

<sup>806</sup> S. Pattanayak, D.D. Arora, C.L. Sehgal, N.G.S. Raghavan, P.K. Topa, and Y.K. Subrahmanyam, 'Comparative Studies of Smallpox Vaccination by the Bifurcated Needle and Rotary Lancet Techniques', *Bulletin of the World Health Organization*, 42 (2) (1970).

<sup>807</sup> K. Kroger, P.M.H. Mazumdar, and J.E. Keelan (eds.), *Crafting Immunity: Working Histories of Clinical Immunology* (Hampshire, 2008), p. 291.

<sup>808</sup> *ibid.*, Interview D.A. Henderson 9 October 2013.

the support of the population being vaccinated.<sup>809</sup> Before the bifurcated needle, the rotary lancet technique was used, which was not only more painful but had less successful vaccination statistics.<sup>810</sup>

In addition, workers and volunteers with clinical expertise were needed to deliver and implement the smallpox vaccine. Hundreds of thousands of public health workers with clinical training were hired to both educate the public on the safety and effectiveness of the vaccine and ensure the on-going management and surveillance of these programmes.<sup>811</sup> The WHO even created a 'Handbook for Smallpox Eradication Programmes in Endemic Areas.'<sup>812</sup> Henderson, the director of the programme, has stated that,

personnel were key and we soon discovered a surprising number of very good young people, in particular, who were enthusiastic, working very hard and who were willing to sacrifice considerable time and effort ... We tried to keep in close communication with all our staff constantly, charting progress, encouraging them and illustrating the successes and possible new approaches. This was not easy without telephones, e-mail or other means of rapid communication. At our Geneva headquarters, there were only nine of us and we never had more than 150 international staff in the field.<sup>813</sup>

The programme even recruited and trained village residents for part-time work, including organizing vaccination programmes and detecting cases.<sup>814</sup> Although indigenous medical leaders and institutions were still resistant to Western medicine, they were seeing empirical evidence that the inoculated side of a village was more likely to survive a smallpox outbreak than the non-inoculated side. An April 1972 report by Dr. Pauline Taylor, a medical superintendent at the mission of St. Luke's in Ummedpur, described the reception given to her staff when they

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<sup>809</sup> Interview D.A. Henderson 9 October 2013.

<sup>810</sup> Pattanayak, 'Comparative Studies of Smallpox Vaccination', p. 305, Interview D.A. Henderson 9 October 2013.

<sup>811</sup> D.A. Henderson, 'Principles and Lessons from the Smallpox Eradication Programme', *Bulletin of the World Health Organization*, 65 (4) (1987), pp. 541–2.

<sup>812</sup> *ibid.*, p. 542.

<sup>813</sup> World Health Organization Bulletin, 'Smallpox: Dispelling the Myths. An interview with Donald Henderson'.

<sup>814</sup> Henderson, 'Principles and Lessons', p. 542.

performed vaccinations for the smallpox campaign. Where previously villagers would run when hearing about a vaccination campaign, now ‘people crowded round readily to be vaccinated.’ Taylor went on to state that she felt as though the villagers’ trust had been gained, and that there was a realization that the medical missions were there to help.<sup>815</sup> Historians have noted for some time that these campaigns have been more successful as trust was built over successive interactions with local villagers.<sup>816</sup> This slow assimilation of Western medicine into rural villages was an extraordinary undertaking, and it occurred despite the fact that *India West* reported that India’s new Prime Minister, Morarji Desai, refused to get vaccinated.<sup>817</sup>

Although the programme was successful, there were many challenges along the way. Programme officials had to constantly evaluate and adapt the programme to the different continents and countries. Henderson has detailed the challenges the programme faced:

A host of problems had to be resolved – special measures were needed to persuade many governments to give the programme adequate support; vaccine production laboratories needed to be developed and improved in many countries; far more funds and personnel were needed than the budget would accommodate; the WHO bureaucracy was unaccustomed to dealing with a programme such as this; new strategies were needed; training programmes and teaching materials had to be developed.<sup>818</sup>

India presented a major challenge due to its large population, civil war refugees, massive floods, and famine. The nation’s northern states, such as Uttar Pradesh and West Bengal, had the

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<sup>815</sup> P.F. Taylor, Report of St. Luke’s Village Health Project. Bodleian Library of Commonwealth and African Studies at the Rhodes House. 30 April 1972. (Special Collection & Western MSS), Oxford, UK.

<sup>816</sup> Bhattacharya, *Fractured States*, p. 225.

<sup>817</sup> ‘Morarji Desai Elected Prime Minister - New Cabinet Announced - Initial Differences Resolved’, *India West*, 1 April 1977.

<sup>818</sup> World Health Organization, Bulletin, Smallpox: Dispelling the Myths. An interview with Donald Henderson.

highest number of smallpox cases and, accordingly, the most problems.<sup>819</sup> On the other hand, the southern states had done a good job vaccinating early on.<sup>820</sup>

India was able to overcome all of the challenges facing it. In *Expunging Variola*, Sanjoy Bhattacharya details the Smallpox Eradication Campaign in India from 1947–77, highlighting the multistage eradication programme that was introduced in India: attack phase, consolidation phase, and maintenance phase.<sup>821</sup> After a mass vaccination in areas with major outbreaks, there would be an extensive field investigation to determine sources of infection.<sup>822</sup> Bhattacharya also outlined the various agencies and institutions required to eradicate smallpox across India.<sup>823</sup> It was the convergence of these elements that led to the eventual eradication of smallpox in India.

Continent	1959	1960	1961	1962	1963	1964	1965	1966	1967*
Africa	16,307	16,823	26,060	24,329	16,863	12,506	16,784	14,127	9,554
Asia	71,309	39,843	53,957	63,616	98,784	43,537	39,145	50,494	50,958
Europe	26	47	24	136	129	—	1	71	3
North America	—	—	—	—	—	—	—	—	—
South America	5,490	7,931	9,026	9,718	7,151	3,398	3,515	3,092	426
Oceania	—	1	—	—	—	—	—	—	—
Total	93,132	64,645	89,067	97,800	122,927	54,441	59,445	67,784	60,941

\* Until 15 July 1967  
 \*\* Consolidated data compiled by WHO from various sources  
 Source: WHO, *Smallpox Eradication*, 7, OPR.

Table 18: Annual number of smallpox cases by continent, 1959–66<sup>824</sup>

In 1975, Henderson official announced that smallpox had been eliminated in India. This was no small feat in a democracy the size of India, with its large rural make-up, and mistrust of Western

<sup>819</sup> Interview D.A. Henderson 9 October 2013.

<sup>820</sup> *ibid.*

<sup>821</sup> Bhattacharya, *Expunging Variola*, p. 106.

<sup>822</sup> *ibid.*, P. Greenough, 'Intimidation, Coercion and Resistance in the Final Stages of the South Asian Smallpox Eradication Campaign, 1973–1975', *Social Science & Medicine*, 41 (5) (1995), pp. 633–45.

<sup>823</sup> Bhattacharya, *Expunging Variola*, p. 63.

<sup>824</sup> *ibid.*, p. 107.

medicine.<sup>825</sup> The *Times of India* published ‘A Salute to Jenner’, noting that, ‘For the first time in recorded history this country is today free of smallpox.’<sup>826</sup> It went on to note that the WHO’s ‘extensive vaccination and revaccination programmes’ were the direct cause for smallpox disappearing from the country.<sup>827</sup> The contributions made by the United States, Soviet Union, Rockefeller Foundation, and WHO demonstrate the significant roles played by various foundations, corporations, government agencies, and multilateral agencies in the effort to eradicate the variola virus.<sup>828</sup>

Smallpox is the first global disease to be eradicated through concerted international effort.<sup>829</sup> The World Health Assembly provided a forum for countries to meet and discuss global health policies and possessed the expertise and international exposure necessary to coordinate a health programme.<sup>830</sup> The participation of the WHO was essential to the progress of the eradication programme: the WHO routinely evaluated the strategy, made necessary changes, and coordinated visits and searches in endemic countries. The global of eradication of smallpox was announced in May 1980 in the Thirty-Third World Health Assembly.<sup>831</sup>

As discussed in this section, the global eradication of smallpox, particularly in India, was an extraordinary achievement in the history of science and medicine, one that highlights the complex of organizations involved in global medical technology diffusion. As Henderson noted,

In 1960s and ‘70s, the programme was beset by major floods, famines, civil war, hundreds of thousands of refugees in various parts of Africa and Asia and we did not have then cell phones, we did not have email, we did not have fax machines, we didn't have Facebook, we didn't have Twitter, telex was possible on some occasions but too expensive. I think it is a testimony to the skill and creativity of

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<sup>825</sup> *ibid.*, p. 60.

<sup>826</sup> ‘A Salute to Jenner’, *Times of India*, 5 July 1975, p. 6.

<sup>827</sup> *ibid.*

<sup>828</sup> Bhattacharya, *Expunging Variola*, pp. 14, 120, 190.

<sup>829</sup> Henderson, ‘Principles and Lessons’, p. 535.

<sup>830</sup> *ibid.*, p. 537.

<sup>831</sup> *ibid.*

the international advisers from some 70 different countries as well as the ministers and health programme staff who managed to overcome all of these and achieve what had been deemed impossible.<sup>832</sup>

Historians, public health professionals, governmental officials, biomedical engineers, and others have learned much from the development, production, and delivery of the vaccine across various geographies and cultures. Social activism directly accelerated the infusion of badly needed resources for the development of advanced treatments and their subsequent diffusion. The eradication of smallpox was the foremost example of not only the impact of the international medical technology complex, but also the emergence of the medical technology complex in an independent India.

The success of the Smallpox Eradication Programme inspired the Centers for Disease Control and Prevention (CDC) to set up the Global Immunization Program.<sup>833</sup> The Global Immunization Division of the CDC, along with other international partners, supports ‘polio eradication, measles, rubella, integrated vaccine preventable disease surveillance, and strengthening immunization systems.’<sup>834</sup> The impact of Global Polio Eradication and Measles Mortality Reduction programs adopted by the World Health Assembly has been astonishing due to the influence of the CDC. Today, there are 99.8 per cent fewer global polio cases, five million fewer cases of paralysis, and more than 250,000 deaths have been prevented. Global measles deaths have also dropped from 733,000 deaths in 2000 to 164,000 in 2008, a 78 per cent decrease.<sup>835</sup>

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<sup>832</sup> World Health Organization Media Centre, Anniversary of Smallpox Eradication Podcast Transcript, Dr. Donald Henderson.

<sup>833</sup> CDC, Centers for Disease Control and Prevention – Global Health. Accessed 9 September 2014 at [www.cdc.gov/globalhealth/programs/immunization.htm](http://www.cdc.gov/globalhealth/programs/immunization.htm).

<sup>834</sup> *ibid.*

<sup>835</sup> *ibid.*

## *Foreword*

*On 8 May 1980, the 155 Member States of the World Health Organization, represented by their delegates to the Thirty-third World Health Assembly, unanimously accepted the conclusions of the Global Commission for the Certification of Smallpox Eradication—namely, that:*

- “1. Smallpox eradication has been achieved throughout the world.*
- “2. There is no evidence that smallpox will return as an endemic disease.”*

*Because of the uniqueness of the achievement and the effect it has already had, and will continue to have, on the lives of people throughout the world, it is important that public health officials, historians and future generations should have access to the evidence upon which these conclusions are based. This book, The Global Eradication of Smallpox, which is the report of the Global Commission, carefully presents and discusses that evidence. It also includes recommendations on policy for the post-eradication era to ensure that this achievement is permanent.*

*The eradication of smallpox has shown that resounding victories can be attained by international cooperation when the objectives are well focused, plans are realistically constructed, and the necessary resources are made available in time. Let this final report of the Global Commission stimulate us all to reflect not only on the eradication of one disease but on how this experience can help us to attack more effectively other health problems with the same enthusiasm, optimism, and sheer hard work that characterized the successful crusade against smallpox.*

H. MAHLER, M.D.  
Director-General

Figure 6: The WHO's official letter certifying the world free from smallpox.<sup>836</sup>

## **V. Application of the Medical Technology Diffusion Theories to the Smallpox Eradication Campaign**

The gap between those segments of the population with access to medical technology and those without was, and continues to be, large in India. The asymmetrical diffusion of medical technology carried with it significant consequences: Indians were dying from smallpox because they lacked access to vaccines. The eradication of smallpox in India demonstrates the extraordinary powers of diffusion of medical technology. Stakeholders including multilateral agencies, governments, corporations, and foundations joined together to eliminate one of

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<sup>836</sup> Bhattacharya, *Expunging Variola*.

history's most virulent diseases. The aggregate group of these institutions navigated the cultural, regulatory, economic, clinical, and supply chain issues needed to vaccinate the global population. The diffusion of medical technology began an evolution that moved India from supplier to producer to inventor to, eventually, the creator of a medical technology super power. Due to the significance of the eradication of smallpox, this section will further analyse the impact of the campaign to the healthcare community. It will apply and evaluate the historical diffusion models detailed in the Introduction to the adoption across India of the smallpox vaccine, slow and diligent as it was. This application is a starting point to aid future members of the healthcare community to create a diffusion theory that includes all necessary factors.

George Basalla's diffusion theory can be applied to the eradication of smallpox in post-independence India. As discussed in the Introduction, Basalla's theory consisted of three stages: exploration, developing nation being trained by Europeans, and the developing nation creating its own scientific tradition.<sup>837</sup> Many developed nations, including the United States and the Soviet Union, came together to eradicate smallpox in developing nations like India. As in the diffusion of modern science, the developed nations were motivated by self-interest: eliminating smallpox protected them from any future outbreaks. As already stated, this programme was implemented during the Cold War, and both the Soviet Union and the U.S.A. hoped to win the favour of developing nations. When the Smallpox Eradication Programme began, India's modern medical technology was limited: even though the nation had access to quantities of the smallpox vaccine, it did not have the resources to vaccinate its large population. Therefore, India, according to Basalla's mode, remained in the 'colonial' phase – a state of dependency. The Smallpox Eradication Programme allowed the developed nations to deploy people and technology within India. These resources educated and trained Indians, allowing the nation to enter the third phase:

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<sup>837</sup> G. Basalla, 'The Spread of Western Science', *Science*, 156 (3775) (1967), pp. 611–22.

an independent medical technology infrastructure. It should also be noted that countries can be at different stages of this diffusion model with different technologies: India, for example, was becoming independent in the field of pharmaceuticals, but was still highly dependent on other nations for medical devices.

The social philosopher Everett M. Rogers has performed a sociological analysis of innovation adoption across large populations. His theory, discussed in the Introduction, defined diffusion as ‘the process by which an innovation is communicated through certain channels over time among the members of a social system.’<sup>838</sup> According to his theory, not every individual in a social system adopts innovation at the same time; therefore he outlined five different adopter categories: innovators, early adopters, early majority, late majority, and finally laggards.<sup>839</sup> Rogers’s theory can be applied to smallpox eradication in India. The innovators were the Indians who were using European health measures, such as the vaccine, from the very beginning. These people were wealthy and members of the elite class, since they were some of the very few Indians with access to European medicine. The early adopters, early majority, and late majority, through the influence of the Smallpox Eradication Programme, slowly began trusting European medicine and allowing themselves to be vaccinated. This was evident by the programme’s use of village residents to help vaccinate and locate outbreaks. The programme especially helped the late majority, who possess limited resources and access to innovation, become vaccinated by making vaccines more accessible to them. Finally, the laggards, or indigenous medical leaders who were the most resistant to European medicine, eventually became vaccinated. Despite their traditional viewpoints, they realized vaccination, and hence European medicine, was necessary.

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<sup>838</sup> E.M. Rogers, *Diffusion of Innovations*, 5th ed. (New York, 2003), p. 11.

<sup>839</sup> *ibid.*, pp. 267, 280.

Since innovation must complete this adoption cycle, the Smallpox Eradication Programme took considerable time.

## **VI. Conclusion: Smallpox Changes the World**

This chapter has examined the converging factors that caused the rapid expansion and growth of medical technology in India in the 1970s. Beginning with the bold regulatory innovations that cemented the development of the medical technology industry, such as the Patents Act of 1970 and the government's introduction of investment incentives and strategic alliances with Indian companies, numerous innovative policies helped India create ensure that its economy, and especially its medical technology sub-economy, continued to grow. This chapter also demonstrated how educational programmes in medical technology were a key to the development of medical technology throughout the 1970s. It was growth in job opportunities that effectively spurred these educational programmes, but the educational programmes themselves were also critical to the growth of medical technology in India in this period. Furthermore, India's entrance into the medical technology complex was finalized with the development of the mass production of the smallpox inoculation on a scale that was unprecedented in Indian history. The fact that India became one of the core smallpox vaccination producers toward the end of the 1970s showed just how far the nation had come. Within the historical analysis of smallpox and its eradication, I have demonstrated the spread of Western medicine and the diffusion of medical technology innovation. My analysis has also shown how aspects of various theories of diffusion were applicable to India at this point in time, in relation to certain types of medical technology.

In looking at the assistance that grew from 1947 to 1979, it is evident from the many multilateral agencies, particularly the WHO, that billions of US dollars were funnelled into India

as aid during the 1970s.<sup>840</sup> The same can be said for private foundations, which aided various parts of the Indian medical technology industry, including malaria control, virus research, fellowships, and other areas of medical education.<sup>841</sup> The commitment by multilateral agencies and private foundations indicated that medical technology was thriving following the new patent regime created from the Patents Act. This relationship had far-reaching consequences, not the least of which was the fact that India, despite breaking the world's most significant intellectual property laws, was still receiving aid from one of the Western world's largest private foundations, as well as one of the world's largest multilateral agencies in the world, the WHO. This was a sign of continued financial support from very powerful agencies independent of corporate factions. Yet despite the growth in India's economy, its exports, and the injection of cash from international monetary organizations and foreign governments, by 1980 India's economy accounted for only 0.57 per cent of the world's total trade volume.<sup>842</sup> By 2000, it was still only 0.71 per cent of global gross domestic product.<sup>843</sup>

From the 1950s and 1960s, India evolved rapidly toward technological self-sufficiency. Through war, martial law, economic crises, and assassination, the country was able not only to eradicate smallpox, but also secure a \$5.8 billion USD loan from the IMF, which was at that point the largest ever given. Moreover, the development, production, and distribution of medical technology grew to levels that India had never seen before: from small pockets of basic manufacturing centres in 1947, to headline-making national pride.<sup>844</sup> Changes in education policy also had a major impact on the development of medical technology in India, resulting in the more rapid diffusion of innovations.

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<sup>840</sup> R. Jeffery, 'New Patterns in Health Sector Aid', *Economic and Political Weekly*, 17 (37) (1982), p. 1498.

<sup>841</sup> *ibid.*

<sup>842</sup> Guha, *India after Gandhi*, p. 699.

<sup>843</sup> *ibid.*

<sup>844</sup> Chatterji, 'Giant Strides Made by our Pharmaceutical Industry', p. 19.

The most notable aspect of the period under review was the adaptability of the Indian government and the leadership of the medical technology industry. Whether developing new investment incentives, trade policies, or international export partners, they repeatedly adapted and reinvented both policy and process. The medical technology industry in India engaged foreign governments and corporations from Communist and socialist-leaning governments, as well as international multi-lateral agencies like the IMF and World Bank, in an on-going effort to expand their reach and sustainability. The medical technology industry proved that even during the most difficult of times, the adoption and export of Western science and technology could not only survive, but thrive.

During the period 1973–84 tensions between the West and India grew as ties between India and the Soviet Union improved. The Soviet invasion of Afghanistan in 1979 brought about a significant Western diplomatic and military response meant to dislodge the Russians from that country. However, President Carter, in bolstering Pakistan's frontiers with Afghanistan, provided defensive military equipment to Pakistan's military.<sup>845</sup> The fear was that any move to arm Pakistan with offensive weaponry would lead to further deterioration in relations with India. This incident demonstrates the extent to which strategic thinking regarding India was at the forefront of American foreign policy in the region. The following chapter will discuss how the dynamics of India's foreign relations changed in the 1980s.

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<sup>845</sup> B. Gwertzman, 'US Offers Pakistan \$400 Million in Aid to Counter Soviet', *New York Times*, 14 January 1980, A1.

## Chapter 7: Medical Technology in the Age of Liberalisation – 1985 to 1991

‘The day will dawn. Hold thy faith firm.’<sup>846</sup>  
– Tagore

The years 1985 to 1991 were bookended by assassination: first that of Indira Gandhi in October 1984, and then that of her son, Rajiv Gandhi, in May 1991.<sup>847</sup> India was relatively politically stable when Rajiv Gandhi became Prime Minister, but his last three years involved a lot of political turmoil, as three Prime Ministers held office from November 1990 to June 1991.<sup>848</sup> Rajiv Gandhi, the son of Indira Gandhi and grandson of Jawaharlal Nehru, took office following his mother’s assassination on the night of October 31, 1985.<sup>849</sup> Despite the unprecedented economic growth in the years in which he held office, Rajiv still lost the national elections of 1989.<sup>850</sup> After he resigned in November 1989, Vishwanath Pratap Singh was elected and sworn as Prime Minister the following month.<sup>851</sup> Not even a year later, in November 1990, Singh’s party was voted out of parliament and Singh resigned.<sup>852</sup> Chandra Shekhar was sworn in as Prime Minister a few days later, but his government fell in March 1991.<sup>853</sup> Rajiv Gandhi was then assassinated on May 21, 1991, and P.V. Narasimha Rao was sworn in as Prime Minister in June 1991.<sup>854</sup> Amidst this political turmoil, India was also in the process of major economic change. Rajiv had started liberalisation efforts before he lost the election in 1989, which Rao

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<sup>846</sup> India’s Planning Commission, Sixth Five-Year Plan, Foreword (written by Indira Gandhi). Accessed 29 July 2014 at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

<sup>847</sup> D.R. Kaarthikenyam and R. Raju, *Rajiv Gandhi Assassination* (New Delhi, 2008), pp. 11, 264.

<sup>848</sup> K. Chowdhury, *The New India: Citizenship, Subjectivity, and Economic Liberalization* (New York, 2011), p. 2.

<sup>849</sup> B. Chandra, M. Mukherjee, and A. Mukherjee, *India After Independence: 1947–2000* (New Delhi, 1999), p. 273.

<sup>850</sup> *ibid.*, p. 285. D.G. Gupte, ‘Reverberations in Global Market after Elections: Money and Banking’, *Times of India*, December 3, 1989, p. 12.

<sup>851</sup> G. Sabharwal, *India Since 1947: The Independent Years* (New Delhi, 2007), pp. 229–30.

<sup>852</sup> *ibid.*, p. 236.

<sup>853</sup> *ibid.*, pp. 236, 240.

<sup>854</sup> *ibid.*, pp. 240–1.

continued.<sup>855</sup> The move towards liberalising the Indian economy elevated its burgeoning medical technology sector to the next level.

One of the best summaries of the challenges India faced in the late 1980s and early 1990s was put forward by Sudipta Kaviraj, an historian from Harvard University.<sup>856</sup> In her paper, ‘Crisis of the Nation-state in India’, she argued that India was in the paradoxical situation of trying ‘to craft imperfect democratic rules by which increasingly mixed groups of people can carry on together an unheroic everyday existence’, whilst perpetuating ‘the illusion of a permanent and homogenous, unmixed, single nation, a single collective self without any trace of a defiling otherness.’<sup>857</sup> The crisis of the nation state, argued Kaviraj, was one in which India had three major objectives. The first was the maintenance of its own integrity; the second was defending political sovereignty; and the third was the maintenance of strong economic development.<sup>858</sup>

This chapter demonstrates that the liberalisation reforms helped the Indian economy grow at an unprecedented rate. The reforms also helped the medical technology sector in India become a fully mature, self-sustainable complex. This chapter will begin by discussing the early liberalisation reforms made in India under Prime Minister Rajiv Gandhi. Second, it will illustrate the positive changes in the medical technology complex during the age of liberalisation. The health of the Indian population was improving as the nation focused on health insurance, family planning, and child health programmes. Third, the chapter will examine the diffusion of medical technologies such as ‘diagnostic vans’, diagnostic medical equipment, and pharmaceuticals. Fourth, India’s relationship with the Soviet Union will be analysed. Finally, the chapter will focus on how the economic crisis and collapse of the Soviet Union in 1991 affected India. Under

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<sup>855</sup> Gupte, ‘Reverberations in Global Market’, p. 12.

<sup>856</sup> S. Kaviraj, ‘Crisis of the Nation-state in India’, *Political Studies* (42) (1994), p. 120.

<sup>857</sup> *ibid.*

<sup>858</sup> *ibid.*, p. 120.

the leadership of new Prime Minister Rao, additional liberalisation reforms were passed that took India's economy to new levels.

### **I. The Effects of Early Liberalisation Efforts**

Liberalisation in general meant that the Indian government would begin to sell off many government-held assets and turn over control to the Indian entrepreneurial class.<sup>859</sup> The arrival of Rajiv Gandhi as India's Prime Minister initiated a process of privatizing parts of India's predominantly government controlled industries: the government enacted a series of pre-liberalisation economic reforms that resulted in the privatization of 23 per cent of India's economic system.<sup>860</sup> Within five years of Rajiv Gandhi's assassination, nearly 85 per cent of output and 91 per cent of employment within the Indian economy was privatized.<sup>861</sup> The privatization introduced by Rajiv led to a substantially improved GDP, with India averaging a rate of 5.6 per cent during the 1980s.<sup>862</sup>

Liberalisation also meant 'increased business entry first by domestic companies and then by foreign firms, some reductions in industry concentration and price-cost margins, and more competitive domestic markets and efficient enterprises.'<sup>863</sup> The piecemeal liberalisation efforts of the 1980s were the beginning of an Indian economy with the characteristics previously outlined. These reforms can be grouped into five categories.<sup>864</sup> First, more capital goods items were added to the Open General Licensing list, which provided access to more imported goods. 'The number

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<sup>859</sup> A. Kohli, 'Politics of Economic Liberalization', *World Development*, (17) 3 (1989), p. 305.

<sup>860</sup> R. Chamarbagwala and G. Sharma, 'Industrial De-Licensing, Trade Liberalization, and Skill Upgrading in India', *Journal of Development Economics*, 96 (2) (2011), p. 316.

<sup>861</sup> *ibid.*

<sup>862</sup> *ibid.*

<sup>863</sup> D. Ireland, 'India's Competition Regimes and Informal Business Institutions: Interaction, Conflict and Accommodation' (Carleton University, D.Phil. thesis, 2008), p. 168.

<sup>864</sup> A. Panagariya, 'The Triumph of India's Market Reforms: The Record of the 1980s and 1990s', *Policy Analysis* 554 (November 2005), p. 7.

of capital goods items on the list expanded steadily, reaching 1,007 by April 1987, 1,170 by April 1988, and 1,329 by April 1990.<sup>865</sup> Second, the share of canalised imports decreased due to increased domestic production.<sup>866</sup> This decrease left room to import machinery and raw materials that were needed to grow businesses. Third, export incentives were introduced and export restrictions relaxed.<sup>867</sup> Fourth, there were changes in many industrial and import controls, i.e. an ‘increase in delicensing, tax reform, and abolition of some controls on price and distribution.’<sup>868</sup> Finally, there was real exchange rate management, which led to growth in Indian exports. Ultimately, these liberalisation reforms moved India’s economy from growth rates of roughly 3 to 4 per cent a year during the 1980s to 5 to 6 per cent per year in the 1990s.<sup>869</sup>

As has been argued throughout this thesis, one of India’s strengths from 1947 to 1991 was its ability to make political pivots, and sometimes even sharp turns. India began courting multinational corporations from the medical technology industry as part of its move to increase foreign direct investment in its industries.<sup>870</sup> One element of this effort involved the government reducing its controls on drug prices, as well as decreasing the number of drugs that would be subject to overall price control.<sup>871</sup> In doing so, Rajiv was hoping that foreign markets from Western multinational corporations would provide a new customer base. This approach was highly fortuitous, as profit margins in the West proved to be an accelerant to medical technology production.

In addition to India moving toward liberalisation during this period, the sixth and seventh five-year plans were also passed. As discussed in Chapter 3, India borrowed the five-year plan

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<sup>865</sup> *ibid.*

<sup>866</sup> *ibid.*, pp. 7–8.

<sup>867</sup> *ibid.*, p. 8.

<sup>868</sup> *ibid.*

<sup>869</sup> Kohli, ‘Politics of Economic Liberalization’, p. 305.

<sup>870</sup> S. Hazarika, ‘India Does an About-Face and Courts the Drug Industry’, *New York Times*, 20 June 1988, p. D5.

<sup>871</sup> *ibid.*

policy making structure from the Soviet Union in 1950, and this contributed to India achieving its highly ambitious development goals during the first decades of independence.<sup>872</sup> The sixth five-year plan produced great results for India; as a result, India's economy was in a positive state in 1985. The actual growth rate was 5.4 per cent, 0.2 per cent greater than the target growth rate of 5.2 per cent.<sup>873</sup> This successful rate was achieved mainly through economic liberalisation, i.e., decreasing restrictions on imports and granting more rights to the private sector.<sup>874</sup> Furthermore, now that smallpox had been eradicated and the nation's health infrastructure strengthened, India was able to focus on family planning.<sup>875</sup>

The seventh five-year plan produced even greater results for India. It accounted for a period of accelerated growth in the mid- to late-1980s, which most historians today attribute to a pent-up demand in the consumer marketplace that is unlikely to be repeated.<sup>876</sup> The plan's foreword discussed the success of the sixth five-year plan and noted that the years from 1985 to 1990 would proceed relative to India's overall development.<sup>877</sup> The plan stated: 'These were years in which the world economy experienced the worst recession since the thirties and most developing countries, and even industrialized countries, faced severe economic difficulties. The Indian economy has emerged stronger, with acceleration in growth.'<sup>878</sup> The result was an annualized growth rate of roughly 4.6 per cent per year.<sup>879</sup> The actual growth rate was 5.7 per cent, 0.7 per cent greater than the target growth rate of 5.0 per cent.<sup>880</sup> The 'pre-liberalisation'

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<sup>872</sup> M.R. Masani, *The Communist Party of India: A Short History* (London, 1954).

<sup>873</sup> L.N. Dash, *World Bank and Economic Development of India* (New Delhi, 2000), p. 114.

<sup>874</sup> India's Planning Commission, Sixth Five-Year Plan, Chapter 7 – Policy Framework.

<sup>875</sup> India's Planning Commission, Sixth Five-Year Plan, Chapter 22 – Health, Family Planning and Nutrition.

<sup>876</sup> D. Kumar (ed.), *The Cambridge Economic History of India*, Volume II c. 1757–2003 (New Delhi, 1983), p. 1034.

<sup>877</sup> India's Planning Commission, Seventh Five-Year Plan, (Vol. I) Foreword. Accessed 25 July 2014 at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

<sup>878</sup> *ibid.*

<sup>879</sup> *Cambridge Economic History of India*, p. 1036.

<sup>880</sup> Dash, *World Bank and Economic Development of India*, p. 114

policies in the seventh five-year plan included opening up formally nationalized industries such as telecommunications, agriculture, and transportation to private ownership.<sup>881</sup> These policies effectively spurred the 4.6 per cent GDP annual growth rate that India enjoyed.<sup>882</sup> In a comparison of gross savings in India, the change from 1985 to 1990 in household savings went from 14.3 per cent to 17.9 per cent, which was on par with previous trends dating back to 1950.<sup>883</sup> However, savings from the public sector declined, coming in between negative 7.6 per cent and negative 8.4 per cent.<sup>884</sup> This decline in public sector savings was an indicator of the success of the pre-liberalisation reforms and a weakening of the socialist government that existed in India.

Rajiv's foreword to the seventh five-year plan also stated that the improvement of healthcare would continue: 'Policies and programmes in education, health and welfare must also be restructured to provide a fuller life for our people.'<sup>885</sup> In his effort to apply science and technology to the healthcare system of India, Rajiv mentioned the use of modern technologies and drugs. Then, in the health and family welfare section of the plan, the use of medical technology was discussed. The plan stated that, 'significant indigenous capacity has been established for the production of drugs and pharmaceuticals, vaccines, Sera, and hospital and other equipment.'<sup>886</sup>

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<sup>881</sup> *Cambridge Economic History of India*, p. 1036.

<sup>882</sup> *ibid.*

<sup>883</sup> R. Kasilingam and G. Jayabal, 'Savings in India-A Critical Analysis', *Journal of Contemporary Research in Management*, 4 (1) (2013), p. 114.

<sup>884</sup> M. Rakshit, *Macroeconomics of Post-Reform India*, Selected Papers Volume I, (New Delhi, 2009), p. 59.

<sup>885</sup> *ibid.*

<sup>886</sup> India's Planning Commission, *Seventh Five-Year Plan*, (Vol. II), Chapter 11 – Health and Family Welfare.

## II. India's Health System in the Age of Liberalisation

During the period under review, there were many changes in the Indian economy that helped accelerate the growth of its medical technology complex. It was clear that the international medical technology complex, having steadily increased its presence in post-colonial India, had achieved a feat that only four decades earlier would have been unthinkable. These changes included the government's creation of a better quality of life measurement, which was a direct result of the improvements in medical technology that will be discussed later in this section. Furthermore, India's increased interactions with the West bolstered its healthcare system. In an effort to improve relations with Western nations and transfer technology abroad, the American Association of Physicians of India, in cooperation with the Health Minister and Medical Council of India, organized a transfer scheme in which doctors from the U.S. would travel to Delhi, Jaipur, Madras, and other cities around India to 'keep the Indian doctors informed about the latest development in medical science.'<sup>887</sup> In addition, the number of Indians living abroad grew substantially from 1980 to 1990; in the United States, for example, the Indian diaspora doubled from 400,000 to 800,000.<sup>888</sup> By 2000, the number had reached 1.7 million, and 3 million in 2011.<sup>889</sup> The Indians living abroad often brought Western technologies and ideas back to their homeland during visits, a transfer of technology and knowledge that began in the more liberalized Rajiv Gandhi administration. The medical technology complex was now growing at roughly 30 per cent a year.<sup>890</sup>

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<sup>887</sup> 'U.S.-Based Indian Doctors to Transfer Technology', *Times of India*, 4 March 1985, p. 8.

<sup>888</sup> T. McComas, 'Mythology Wars, the Indian Diaspora and Debating the Hindu past', *Asian Studies Review* (35) 2 (2011), p. 152.

<sup>889</sup> *ibid.*

<sup>890</sup> Indian Institute of Food Technologists, Pharmaceuticals: A Sector Study Summary (1991), Unpublished Report, p. 1. Accessed at Lady Harding Medical School Archives, New Delhi.

This section will begin by discussing the additional development of healthcare services and educational institutions, the implementation of massive contraceptive campaigns, the establishment of infant and maternal health programmes, and the increased availability of health insurance policies like Mediclaim. Then it will examine the ways in which India still lagged far behind most Western nations in total healthcare expenditures relative to GDP. In fact, it was not until 1983 that India implemented a formal national health policy.<sup>891</sup> Prime Minister Rajiv Gandhi eventually bridged this gap in healthcare and implemented significant changes. An impressive indicator of medical technology diffusion across India was its quality of life measurements. An unpublished report from the Institute of Chartered Financial Analysts of India detailed the nation's key health indicators.<sup>892</sup> India's life expectancy at birth stood at 37 in 1951; by the year 2001, it was 63, about two years below the average for developing nations. In terms of infant mortality, the deaths per 1,000 births in 1951 were 146; by 2001, this figure had declined to 70. The morbidity level – meaning the incidence of disease per 10,000 person population – in 1990 was 339 days; in 2001 it was 274 days, compared to an average of 256 for developing countries.<sup>893</sup> In 1951, there were 75 million cases of malaria in a population of roughly 350 million; by 2000, it had gone down to 2.2 million in a population of roughly one billion.<sup>894</sup> The number of cases of deaths due to malaria in 1945 was 100,000, a figure that had dropped to just 213 in 1985.<sup>895</sup> The number of deaths from smallpox in 1985 had dropped to 0, following an annual death rate in 1941 of 69,474.<sup>896</sup> The number of hospital beds for both public

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<sup>891</sup> D.H. Peters (ed.), *Better Health Systems for India's Poor: Findings, Analysis, and Options* (World Bank Publications, 2002), p. 333.

<sup>892</sup> N. Chowdary (ed.), *Healthcare Sector* (Hyderabad, 2003), p. 5.

<sup>893</sup> *ibid.*

<sup>894</sup> The reduction of malaria was also due to the heavy use of DDT to suppress the mosquito population. Government of India, Ministry of Health and Family Welfare, *National Health Policy 2002* (New Delhi, 1996).

<sup>895</sup> 'Council for Social Development', p. 277.

<sup>896</sup> *ibid.*, p. 278.

and private healthcare in 1951 was 117,198; by 2000, that figure stood at 870,161.<sup>897</sup> Finally, in 1951, there were 61,801 physicians, which had grown to 503,900 by the close of the century.<sup>898</sup>



*Figure 7: The Rajiv Gandhi Centre for Biotechnology stands as a testament to his commitment to medical technology*<sup>899</sup>

In addition, more educational institutions were being created to provide increased health industry opportunities for Indians. By 1991, there was an increase in medical colleges in India.<sup>900</sup> In 1951, medical colleges across all of India numbered only 30. By 1991, that number stood at 128. The number of students attending these medical schools in 1951 was 1,600, and in 1991 it was 13,934.<sup>901</sup> In 1990 the Centre for Development of Education, Science and Technology was established in Thiruvananthapuram, the capital city of Kerala, as a small charitable society.<sup>902</sup> It would later be renamed and restructured as the Rajiv Gandhi Centre for Biotechnology (RGCB)

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<sup>897</sup> B. Khadria, 'International Nurse Recruitment in India', *Health Services Research*, 42 (3p2) (2007), p. 1436.

<sup>898</sup> D.H. Peters (ed.), *Better Health Systems for India's Poor*, p. 14.

<sup>899</sup> Universiti Teknologi Malaysia. Accessed at [www.cheme.utm.my/cheme/index.php/global-outreach-programme/2010/bioprocess-student-society-india-trip-2010](http://www.cheme.utm.my/cheme/index.php/global-outreach-programme/2010/bioprocess-student-society-india-trip-2010).

<sup>900</sup> 'Council for Social Development', *India Social Development Report 2008: Development and Displacement* (New York, 2008), p. 277.

<sup>901</sup> *ibid.*

<sup>902</sup> Rajiv Gandhi Centre for Biotechnology. Accessed 5 September 2014 at [www.rgcb.res.in/profile.shtml](http://www.rgcb.res.in/profile.shtml).

in honour of ‘the young illustrious and visionary former Prime Minister of India.’ The centre has subsequently ‘attained national and international recognition with leading discoveries and findings in medical and plant biotechnology.’ Today, the centre’s research programs are based on the central theme of Disease Biology, i.e. human disease, animal disease and plant disease. There is a Cancer Research Program, a Cardiovascular Biology Program, Infectious Disease Biology, Neurobiology, Reproductive Biology and Infertility, Genetics of Disease and a program for the use of chemical biology in disease research.<sup>903</sup>

Most of the early family planning efforts in the pre-emergency era of India’s history were not successful.<sup>904</sup> There was even an official Family Planning Programme introduced in 1952 in the first five-year plan, however, it only started getting attention only in 1966-67.<sup>905</sup> Although considerable money and resources had been invested in controlling fertility in India in the 1950s, there was very little evidence to show the participation of the Indian people.<sup>906</sup> During the 1970s, India’s improved healthcare system in certain urban areas was also increasing the overall population, making family planning necessary to control overpopulation.<sup>907</sup> Other factors such as ‘higher level of literacy and education, more particularly female education, better status enjoyed by women and greater availability of employment opportunities to them’ also made family planning more important to Indians.<sup>908</sup>

By the 1970s, there was increasing evidence to show that family planning efforts had been successful.<sup>909</sup> Efforts included large-scale sterilization programs, which were well promoted

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<sup>903</sup> *ibid.*

<sup>904</sup> M. Vicziany, ‘Coercion in a Soft State: The Family-Planning Program of India: Part 2: The Sources of Coercion’, *Pacific Affairs* (1982), p. 557.

<sup>905</sup> India’s Planning Commission, Sixth Five-Year Plan, Chapter 22 – Health, Family Planning and Nutrition.

<sup>906</sup> Vicziany, ‘Coercion in a Soft State’, p. 557.

<sup>907</sup> India’s Planning Commission, Sixth Five-Year Plan, Chapter 22 – Health, Family Planning and Nutrition.

<sup>908</sup> *ibid.*

<sup>909</sup> Vicziany, ‘Coercion in a Soft State’, p. 562.

and implemented due to the modernization of India's public health service.<sup>910</sup> The birth control pill had also been widely diffused over many of the more populous states in India in the late-1960s and early-1970s.<sup>911</sup> International agencies such as USAID, the Ford and Rockefeller foundations, the Population Council, and several United Nations agencies also assisted with the family planning programmes.<sup>912</sup> For example, the United Nations Fund for Population Activities (UNFPA), now officially renamed the United Nations Population Fund, helped develop family planning programs in India.<sup>913</sup> Whilst the implementation and diffusion of medical technology was successful in these cases, it was also extraordinarily controversial relative to other medical technology administration in India's history.<sup>914</sup>

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<sup>910</sup> *ibid.*, p. 562.

<sup>911</sup> *ibid.*, p. 564.

<sup>912</sup> S. Engh, 'Population Control in the 20th Century: Scandinavian Aid to the Indian Family Planning Programme' (University of Oxford, D.Phil. thesis, 2005), p. 126.

<sup>913</sup> UNFPA, Accessed 25 July 2014 at <http://unfpa.org/public/home/about>.

<sup>914</sup> Vicziany, 'Coercion in a Soft State', p. 575.



Figure 8: Doctor in a Birth Control Clinic in India<sup>915</sup>

Population growth began to decline, a reflection of the massive contraceptive deployment and implementation that public health officials had taken over the previous three decades, as well as the success of the family planning programmes.<sup>916</sup> In 1984, India's population was the second largest in the world.<sup>917</sup> By 1991, it had reached 846 million people, including a population growth of 163 million from 1981–91.<sup>918</sup> But whilst India ranked as the second largest country in the world, its growth rate had slipped to 2.4 per cent compounded annual growth rate, coming off decades of record growth between 1961–81 that had seen 2.5 per cent annual population growth.<sup>919</sup> It will be very important to keep developing family planning programmes in India,

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<sup>915</sup> W. Morehouse (ed.), *Science and the Human Condition in India and Pakistan* (Vol. 69) (New York, 1968), p. 139.

<sup>916</sup> Connelly, *Fatal Misconception*, p. 155.

<sup>917</sup> M. Ravallion and G. Datt, 'India's Checkered History in Fight against Poverty: Are There Lessons for the Future?', *Economic and Political Weekly* (1996).

<sup>918</sup> T. Roy, *The Economic History of India, 1857–1947* (New Delhi, 2000), p. 270.

<sup>919</sup> *ibid.*

since ‘India is projected to become the world’s most populous nation by 2028, with a population of some 1.45 billion.’<sup>920</sup>

In the mid-1980s to 1990s, the emphasis was on mother and child health projects.<sup>921</sup> The 1986 annual report of the United Nations Children Fund declared that Rajiv Gandhi wanted to achieve universal immunization, including children, by 1990, as ‘a living memorial’ to his mother.<sup>922</sup> The report highlighted how 60 per cent of hearing aids provided by Gandhi Hospital in the state of Andhra Pradesh went to children under six years old. These children did not have the necessary training to know how to use the hearing aids.<sup>923</sup> Therefore, a training programme was developed to teach the mothers of the deaf children how to use the hearing aids. This example shows that India’s health sector was advancing and able to deal with more specialized health

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<sup>920</sup> UNFPA – India, Accessed 25 July 2014 at <https://data.unfpa.org/docs/ind>.

<sup>921</sup> Eng, ‘Population Control in the 20th Century’, p. 125.

<sup>922</sup> ‘UNICEF United Nations Children Fund’, UNICEF Annual Report 1986 (1987), p. 8. Accessed at [www.unicef.org/about/history/index\\_annualreports.html](http://www.unicef.org/about/history/index_annualreports.html).

<sup>923</sup> *ibid.*, p. 27.

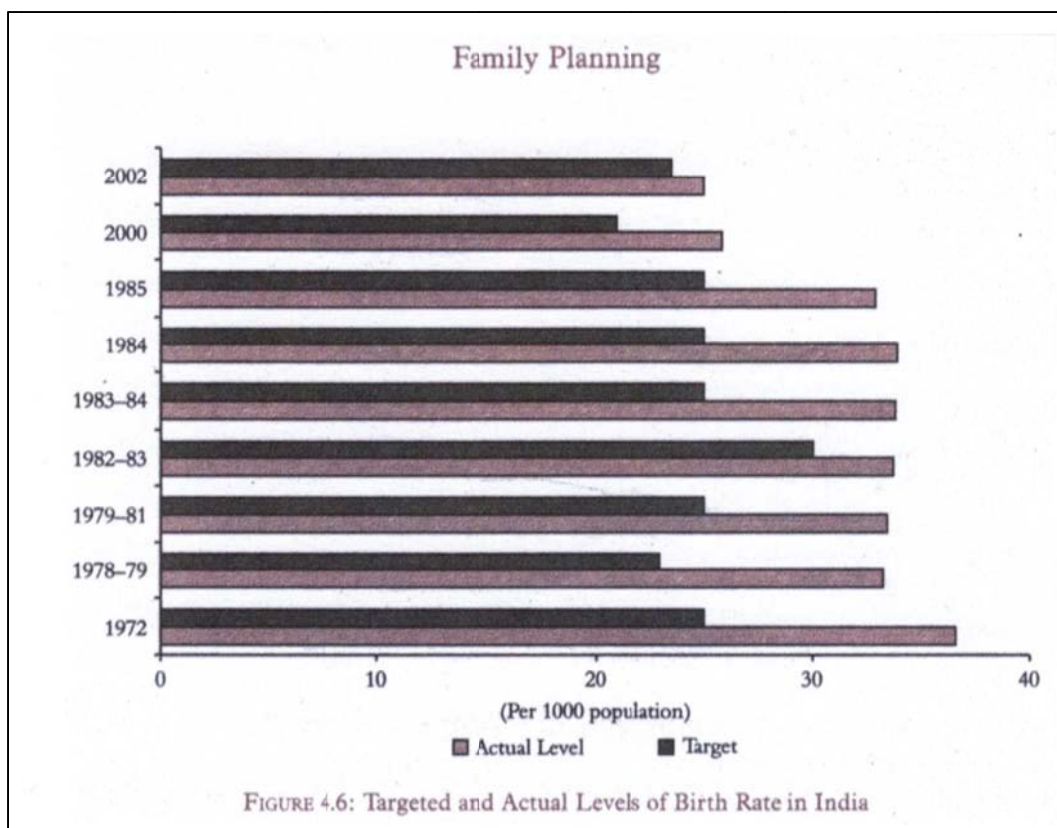


FIGURE 4.6: Targeted and Actual Levels of Birth Rate in India

Table 19: Targeted v. Actual Levels of Birth Rate in India, 1972–2002 <sup>924</sup>

concerns of children. The report also shows that \$140,437,000 was committed by UNICEF for 1986–89 for mother and child health programmes in India.<sup>925</sup> Many of these programmes involved immunization and water cleaning technologies, as well as supplying drugs for diseases such as cholera and guinea worm.<sup>926</sup> In the early-1990s, the Indian Ministry of Health and Family Welfare even launched a ‘Child Survival and Safe Motherhood Programme’ for maternal health.<sup>927</sup> The government has continued to focus on implementing programmes that improve

<sup>924</sup> A.R. Chaurasia and S.C. Gulati, *India: The State of Population 2007* (Oxford, 2008), p. 55.

<sup>925</sup> *ibid.*, p. 29.

<sup>926</sup> *ibid.*

<sup>927</sup> Engh, ‘Population Control in the 20th Century’, pp. 125–26.

healthcare, for example, launching the National Rural Health Mission in 2005.<sup>928</sup> The goal of this mission was to provide ‘accessible, affordable and quality healthcare to the rural population, especially the vulnerable groups.’<sup>929</sup>

Healthcare insurance in India was very limited prior to the pre-liberalisation reforms. The two main forms of health insurance at this time were the Employees State Insurance Scheme (ESIS) and Mediclaim.<sup>930</sup> The ESIS is managed by the Employees State Insurance Corporation, a wholly government-owned enterprise, and was established in 1948. It originally provided cash and medical benefits to ‘factories which have been “using power” and employing 10 or more workers.’<sup>931</sup> Then, in 1989, coverage was expanded to ‘factories which are “not using power” and employing 20 or more persons.’<sup>932</sup> The General Insurance Corporation (GIC) was established in 1973 as ‘a public sector organisation to market a range of insurance services.’<sup>933</sup> Then, in 1986, the GIC introduced the health insurance policy known as Mediclaim.<sup>934</sup> Although the concept of health insurance for the general public in India was new, the number of subscribers to these plans grew at a steady pace between 1985 and 1991. Mediclaim, a government-owned insurance corporation that was quickly privatized, was the largest of these plans. It grew at a steady, if not overwhelming, rate: there were 167,726 covered members in 1987, a figure that had risen to 697,018 by 1991.<sup>935</sup> This growth rate showed the promise for health insurance to work within the

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<sup>928</sup> National Health Mission, Ministry of Health & Family Welfare, Government of India, NRHM Framework for Implementation. Accessed 11 August 2014 at <http://nrhm.gov.in/nhm/nrhm/nrhm-framework-for-implementation.html>.

<sup>929</sup> *ibid.*

<sup>930</sup> R. Ellis, M. Alam, and I. Gupta, ‘Health Insurance in India: Prognosis and Prospectus’, *Economic and Political Weekly* (35) 4 (2000), p. 210.

<sup>931</sup> *ibid.*

<sup>932</sup> *ibid.*

<sup>933</sup> *ibid.* p. 211.

<sup>934</sup> *ibid.*; P.S. Palande, R.S. Shah, and M.L. Lunawat, *Insurance in India: Changing Policies and Emerging Opportunities* (New Delhi, 2003), p. 212.

<sup>935</sup> Ellis, ‘Health insurance in India’, p. 209.

Indian healthcare system; Western thinking typically views health insurance as a driver for medical technology adoption.<sup>936</sup>

Year	Number of Policies Issued	Number of Covered Persons	Total Premium Revenue (Rs Million)	Claim Amount Settled (Rs Million)	Number of Claims Reported	Number of Claims Settled
<i>Calendar year</i>						
1987	1,08,298	1,67,726	79.9	3.3	3,812	1,759
1988	1,27,791	1,91,865	112.9	34.9	22,411	16,181
<i>Fiscal year</i>						
1989-90	39,288	6,49,850	240.3	74.4	42,241	34,107
1990-91	1,65,283	5,66,791	278.4	145.6	55,764	45,939
1991-92	1,91,510	6,97,018	344.7	156.0	40,567	30,630
1992-93	2,52,163	9,85,674	489.2	239.9		
1993-94	4,40,377	12,76,509	974.3	426.4		
1994-95 (partial year results)	4,88,000	17,83,000	1,146.1	569.8		
<i>Percentage change (1989-90 to 1994-95)</i>						
	250	174	377	666	-	-

*Source: Tables provided by the General Insurance Corporation, 1996.*

Table 20: Mediciam Statistics: 1987-1995<sup>937</sup>

Despite all these changes in the medical technology complex, there was still not an increase in total healthcare expenditures relative to Gross Domestic Product (GDP). In a book published in India in 2007, Himanshu Sekhar Rout, an economist from IIT Kanpur, wrote extensively about healthcare finances in India over the last thirty years, focusing on expenditures between 1980 and 2001 as a percentage of GDP. In 1981, the number was 0.80 per cent, and by 1990 it was 0.92 per cent.<sup>938</sup> The very slight increase in GDP percentage was far outpaced by the growth of the population, resulting in a net decline. In fact, relative to other nations, it should be seen as a retardant, given that the government spent so little in the area of healthcare to aid its own citizens and improve the medical technology industry within India itself.

<sup>936</sup> M.E. Chernew, R.A. Hirth, S.S. Sonnad, R. Ermann, and A.M. Fendrick, 'Managed Care, Medical Technology, and Health Care Cost Growth: A Review of the Evidence', *Medical Care Research and Review* 55 (3) (1998), p. 281.

<sup>937</sup> Ellis, 'Health Insurance in India', p. 207.

<sup>938</sup> H.S. Rout, *Health Economics in India* (New Delhi, 2007), p. 235.

In the 1950s and '60s, Indian spending on healthcare, much of it in the medical technology arena, was at much higher levels than traditionally seen in developing nations.<sup>939</sup> By 1990, the total amount of money spent on the healthcare system had dropped to a more normalized developing country rate of a 1.3 per cent of GDP.<sup>940</sup> The drop in spending on healthcare represented a betrayal of the central government's goal of providing basic medical services to populations in great need. The consequent effect on medical technology development was also harmful, given the fact that India was the world's second most populous nation and its medical technology complex was also one of the largest. The kind of spending on healthcare and medical technology seen in the first two decades of independence could have been an opportunity for the government to dramatically improve the health of its own people whilst also vastly expanding the medical technology complex through a programme of domestic spending in technology and its diffusion.

### **III. The Growth of Domestic Indian Medical Technology**

The sixth and seventh five-year plans highlighted several key areas in medical technology development. This was the first time medical technology had received such a prominent place in India's key planning document. The spread of western science was not just becoming more visible in the government's overall national spending plan, but also in the popular daily news coverage. First, this section will discuss how the Indian press viewed medical technology; most articles were proud of India's advancement in the medical field, but, as always, there a few critics remained. After a looking at the media, the diffusion of medical technologies in India between 1985 and 1991 will be evaluated. Technologies such as the mobile laboratory on

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<sup>939</sup> Eikemo, 'The Welfare State: A Glossary for Public Health', pp. 3–6.

<sup>940</sup> Guha, *India after Gandhi*, p. 706.

wheels, ‘diagnostic van’, and medical diagnostic tools such as X-rays, ECGs, and ESGs were more widespread than in early post-independence India. India was also being exposed to various drugs from international markets. Finally, this section will examine how the cost and complexity of certain medical devices delayed the diffusion of those technologies.

**a. A Look at Medical Technology Through the Eyes of the Indian press**

The Indian press has long been fascinated with medical technology. The early history of advertising in the Indian press, as elsewhere, was dominated by advertisements for potions, pills, balms, and other products for the curing of ills. Numerous writers throughout this period bemoaned the declining vitality of the Indian ‘race’, once hale and hearty, now pallid and sickly, losing its vigour through unthinking imitation of the ways of the conqueror.<sup>941</sup> The interest in medical technologies had been part of the middle class reading segment of Indian culture dating back to the later part of the nineteenth century.<sup>942</sup> This was evident in the post-colonial Indian press as well, particularly once the Indian medical technology complex arose in the late-1970s and early-1980s.

In the years from 1985-91, it became clear that the press took the advances in India’s medical technology as a point of national pride. In the February 12, 1986 issue of the *Times of India*, there was an article entitled, ‘New Age in Indo-U.S. Ties’, the theme of which was the perceived gap between America and India in medical technology: ‘Many Americans seemed incredulous to hear my report that medical technology available here, and medical treatment, were first class.’<sup>943</sup> The article argued that the U.S.A. would ‘augment’ these new growth sectors

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<sup>941</sup> S.S. Amrith, *Health and Well-Being in Colonial and Postcolonial India*, p. 5. Accessed at [www.princeton.edu/chw/events\\_archive/repository/03272006\\_amrith/03-27-07.pdf](http://www.princeton.edu/chw/events_archive/repository/03272006_amrith/03-27-07.pdf).

<sup>942</sup> *ibid.* p. 4.

<sup>943</sup> A. Trevithick, ‘New Age in Indo-U.S. Ties’, *Times of India*, 12 February 1986, p. 8.

in the subcontinent's economy by playing a critical role in the continued growth of the Indian medical technology industry. Clearly, the article's author had a more prescient view of the future than nearly everyone else at the time. A 1987 article in *India – West* stated that, 'Scientific achievements since independence have been significant. These include eradication of smallpox, introduction of a domiciliary treatment of tuberculosis and major advances relating to nutritional disorders.'<sup>944</sup>

Furthermore, in September 1990, the *Times of India* published an article about the national media attention being given to India's new medical technology sector. In the article, entitled 'National versus International', the author compared India to Japan relative to the number of Magnetic Resonance Image (MRI) machines per million, which stood at 30 machines per million in Japan but only 0.15 per device in India.<sup>945</sup> The article also discussed the bank loans required to purchase the equipment, which at the time carried between 10 and 16 per cent compounded annual interest, as well as a government tax of 40 per cent on most revenues from the equipment themselves.<sup>946</sup> The article continued to discuss India's unprecedented fascination with modern medical technology.

The press was not interested simply in the development of new technologies, but also the advantages of the new technologies. On November 19, 1990, the Indian press hailed the nation's progress in medical technology with an article by Professor D.R. Endzmann, who proclaimed the advantages of the MRI device.<sup>947</sup> In the article, Endzmann detailed the number of diseases the MRI was able to detect, before going on to say that the key to a successful treatment of a disease

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<sup>944</sup> R.S. Anand, 'Reflections on Forty Years of Freedom', *India – West*, 14 August 1987.

<sup>945</sup> Sachidananda, 'National vs. International', *Times of India*, 20 September 1990, p. 15.

<sup>946</sup> *ibid.*

<sup>947</sup> 'Advantages of MRI', *Times of India*, 19 November 1990, p. 20.

was the ability to catch it at its earliest stage.<sup>948</sup> Another physician, Dr. Barella from New Delhi, stated in a separate publication in December 1991 that the technology gap between India and the rest of the world had been reduced from 7 to 8 years to 3 to 4 years.<sup>949</sup> He said that a key element to the reduction in the technology gap was the high level of medical education that Indian physicians were receiving.<sup>950</sup> The Indian medical technology complex had only recently progressed from eradicating smallpox, and was now competing with the other world powers in terms of medical technology.

However, the press coverage of medical technology in India was not entirely favourable. A 1995 paper by University of Arizona anthropologist Mark Nichter regarding the perceptions of vaccination programmes by local communities in India.<sup>951</sup> Some of his field notes included extremely critical news accounts of anti-fertility campaigns and vaccine trials, with the Indian press publishing claims that Indians were being used as lab animals (despite the fact that the vaccines had already been through a clinical trial process in the United States).<sup>952</sup> Given the evidence both praising the benefits of medical technology and warning of the risks, it appears as though the medical technology complex in India received a balanced account, both positive and critical, from the Indian press.

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<sup>948</sup> *ibid.*

<sup>949</sup> 'Trends in Medical Diagnosis in India', *Times of India*, 17 December 1991, p. 13.

<sup>950</sup> *ibid.*

<sup>951</sup> M. Nichter, 'Vaccinations in the Third World: A Consideration of Community Demand', *Social Science & Medicine*, 41 (5) (1995), pp. 617–632.

<sup>952</sup> *ibid.*, p. 618.

## **b. Diffusion of Medical Technologies in India between 1985 and 1991**

One of the key developments that occurred in the diffusion of medical technologies between 1985 and 1991 was the increasing use of the mobile laboratory, or ‘diagnostic van.’ The diagnostic vans were highlighted in a book entitled *The Indian Pharmaceutical Industry Since Independence* by P.K. Ravindranath.<sup>953</sup> Citing a study of a 1972 drought carried out by A.K. Banerjee, one of India’s foremost geographers, Ravindranath concluded that ‘over 22,000 villages had no medical care facilities of any kind.’<sup>954</sup> In response, Banerjee set out to develop a mobile laboratory on wheels; over the course of the next ten years, he established the Sandoz mobile diagnostic van, which consisted of three tons of equipment, including microscopes, hot ovens, a centrifuge, and various other biomedical data collection tools such as blood pressure cuffs, stethoscopes, thermometers, and weight scales. The vans were also equipped with drugs, medicines, and vaccines to help aid people in remote villages around India. The programme acquired the support of Prime Minister Rajiv Gandhi, who asked for additional units to be sent to Amethi.<sup>955</sup> These vans provided healthcare to enormous populations in rural India between 1985 and 1991. In a single month, one van covered fourteen different villages in Aurangabad, Bhokerdan, and Paithan, treating 978 patients and completing 409 physicals. The diagnostic vans helped to diagnose various health issues, including respiratory infections, fevers, anaemia, tuberculosis, and guinea worm.<sup>956</sup>

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<sup>953</sup> P.K. Ravindranath, *The Indian Pharmaceutical Industry* (New Delhi, 2011), p. 181. The book explains how the managing director of Sandoz in India steered his company through the various shifts in India’s industry from the 1950s through the 1990s.

<sup>954</sup> *ibid.*

<sup>955</sup> *ibid.*, p. 187.

<sup>956</sup> *ibid.*, p. 188.

<b>Table 3. Proportion of all patients getting an X-ray/ECG/ESG in 1986–87 and 1995–96, all India (%)<sup>a</sup></b>		
Care type and residence	X-ray/ECG/ESG	
	1986–87	1995–96
<b>Inpatients</b>		
Rural	33.63	43.06
Urban	45.16	52.07
Rural + urban	36.82	46.39
<b>Outpatients</b>		
Rural	2.90	3.61
Urban	5.47	6.34
Rural + urban	3.57	4.41

<sup>a</sup> Source: Authors' estimates are based on data from the 1986–87 and 1995–96 household surveys of healthcare utilization and expenditure by the National Sample Survey Organization (NSSO).  
ECG, electrocardiogram; ESG, electrosonogram.

Table 22: Table showing increase in diagnostic services <sup>957</sup>

The development of the mobile diagnostic vans was an example of how India was developing its own medical technology to meet its needs. Western science was being retooled and developed by Indians, for Indians. Beyond the diagnostic vans themselves, medical technologies of all kinds were more widely diffused than before. From 1987 to 1996, the numbers of patients receiving diagnostic services such as X-rays, ECGs, and ESGs increased. Household expenditures on diagnostic services continued to increase even after 1991. Diagnostic expenditures accounted for a quarter of the ‘increase in the share of healthcare in total spending by households.’<sup>958</sup> There were various causes for this increase in diagnostic services in India during this period, including more non-resident Indian clinicians returning home, most of whom were familiar with modern diagnostic tools and high-end equipment. This trend in the increase of imports in medical devices continued into the 2000s.

<sup>957</sup> A. Mahal, A. Varshney, and S. Taman, ‘Diffusion of diagnostic medical devices and policy implications for India’, *International Journal of Technology Assessment in Health Care*, (22) 2 (2006), p. 187.

<sup>958</sup> *ibid.*

**Table 2.** Imports of medical devices by value, 1991–2003, all India (1993–94 Rupees millions)<sup>a</sup>

Device type	3-year totals			
	1991–4	1994–7	1997–2000	2000–3
CT apparatus	n.a.	>53.81	544.01	1647.47
CT scanner (NW)	357.08	187.41	234.58	464.46
MRI apparatus	n.a.	557.75	713.67	2687.96
Scanner (whole body)	422.94	213.04	312.33	436.45
Cardiac catheters (000s)	542.32	473.47	1621.18	2364.04
ECG	102.12	109.60	289.03	226.43
Linear ultrasound scanner	388.63	689.66	816.16	2477.50
Endoscopes	97.00	125.33	108.65	399.02
Fibrosopes	n.a.	47.55	71.53	90.42
Angiograph	n.a.	n.a.	567.05	804.11

<sup>a</sup> Measurement units of CT apparatus and MRI apparatus are based on Indian customs definitions; gross domestic product deflator used to convert current Rupee prices into 1993–94 prices. *Source:* Foreign Trade Statistics of India, published by the Directorate General of Commercial Intelligence and Statistics, Government of India (various years). ECG, electrocardiograph; NW, CT scanner other than whole body; n.a., not applicable; MRI, magnetic resonance imaging; CT, computed tomography.

Table 23: Imports of Medical Devices, 1991–2003<sup>959</sup>

As the Indian market grew, new pharmaceutical technologies from different parts of the world began making their way to the subcontinent. The Indian government also began approving drugs that were not licensed in other major regulatory markets; for example, Leucoderma, a Cuban-developed drug used in the treatment of vitiligo and other skin diseases.<sup>960</sup> In December 1990, India also approved Virazole, a brand name for ribavirin that had been rejected in the United States. Virazole, available as both a tablet and syrup, was used to treat various types of herpes infection, and it was also regarded as an effective option for HIV/AIDS.<sup>961</sup> It had recently been improved in Ireland and was being tested further for HIV use in a broader population.<sup>962</sup> Leucoderma and Virazole represent two more cases in which the Indian government expanded

<sup>959</sup> *ibid.*, p. 186.

<sup>960</sup> ‘Leucoderma Drug in India soon’, *Times of India*, 29 November 1989, p. 5.

<sup>961</sup> A. Sikri, ‘India Approves Use of U.S. drug’, *India Abroad* (15) (1990), p. 1.

<sup>962</sup> *ibid.*

its domestic pharmaceutical technology offerings in order to spur foreign investments in the Indian medical technology market.

India also began to develop its pharmaceutical sector. Numerous pharmaceutical companies were founded in India during this time. Biocon led the development of pharmaceuticals after it was founded in Bangalore, India in 1978 by Kiran Mazumdar-Shaw.<sup>963</sup> Its products targeted diabetes, cancer, and inflammatory diseases. In 1979, Biocon was ‘the first Indian company to manufacture and export enzymes to USA and Europe.’<sup>964</sup> In 1989, it was also the first Indian biotech company to receive funding from the USA. Other companies followed. Sun Pharmaceutical Industries Limited, located in Mumbai, began in 1983 with five products treating psychiatric ailments, which were sold in only two states in India.<sup>965</sup> In 1987, there were sales nationwide, and two years later the company began exporting to neighbouring countries.<sup>966</sup> Dr. Reddy’s Laboratories was established in 1984 and ‘entered the bulk-generics market by reverse engineering foreign drugs and devising new means of mass-manufacturing generic alternatives at costs attractive to the Indian market.’<sup>967</sup> The company went international in 1991.<sup>968</sup> Dr. Reddy’s remains a significant company today.<sup>969</sup> Aurobindo Pharma, ‘a R&D-driven company with a broad manufacturing portfolio and capabilities’, was founded in 1986 and is headquartered in Hyderabad.<sup>970</sup> Aurobindo Pharma became a public company in 1992.<sup>971</sup> Today,

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<sup>963</sup> V. Wadhwa, B.A. Rissing, G. Gereffi, J. Trumpbour, and P. Engardio, ‘The Globalization of Innovation: Pharmaceuticals: Can India and China Cure the Global Pharmaceutical Market’, Kauffman, ‘The Foundation of Entrepreneurship’ (June 2008), p. 31. Accessed 5 September 2014 at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1143472](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1143472).

<sup>964</sup> Biocon. Accessed 5 September 2014 at [www.biocon.com/biocon\\_aboutus\\_history.asp](http://www.biocon.com/biocon_aboutus_history.asp).

<sup>965</sup> Wadhwa, ‘The Globalization of Innovation’, p. 50.

<sup>966</sup> Sun Pharma, History. Accessed 5 September 2014 at [www.sunpharma.com/history](http://www.sunpharma.com/history).

<sup>967</sup> Wadhwa, ‘The Globalization of Innovation’, p. 36.

<sup>968</sup> Dr. Reddy’s, India. Accessed 5 September 2014 at [www.drreddys.com/india/](http://www.drreddys.com/india/).

<sup>969</sup> Wadhwa, ‘The Globalization of Innovation’, p. 36.

<sup>970</sup> *ibid.*, p. 28

<sup>971</sup> Aurobindo, About Us. Accessed 5 September 2014 at [www.aurobindo.com/about-us/overview](http://www.aurobindo.com/about-us/overview).

it exports to over 125 countries, and more than 70 per cent of its revenues are from international operations.<sup>972</sup>

The emergence of all these new pharmaceutical companies enabled India to become one of the top ten pharmaceutical technology exporters in the world, alongside many leading nations such as the United States, Russia, Switzerland, and Germany. An unpublished report on the use of medical technology in the pharmaceutical industry authored by the India Institute of Food Technologists stated that India's largest export partner for its medicines from 1989–90 was the Soviet Union, which took in 44.2 per cent of all of India's exports, followed by France with 13.4 per cent, and the U.S. with 3.9 per cent.<sup>973</sup> The same report stated that the production of drugs and formulations from 1988–89 increased by 30 per cent year over year, 'the highest growth rate achieved in any singular year during the past decade.' The report also pointed out that India's per capita drug consumption was amongst the lowest in the world. The average amount spent on pharmaceuticals per person in India was about 2 U.S. dollars per capita, versus roughly 40 dollars per capita in developed countries in 1995 dollars.<sup>974</sup>

Whilst India was a net exporter of pharmaceuticals, the domestic market was not dominated by any single group. In fact, the largest medical technology company by market shares was Ranbaxy Laboratories with 5.87 per cent, with the second largest being Glaxo India at 3.26 per cent.<sup>975</sup> This was a hallmark of the Indian medical technology industry: heavily fragmented and extremely competitive. And, from the medical technology manufacturers' perspective, there were no programs in place for helping patients in India cover the costs of

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<sup>972</sup> *ibid.*

<sup>973</sup> Indian Institute of Food Technologists, *Pharmaceuticals: A Sector Study Summary* (1991), p. 3.

<sup>974</sup> *ibid.*, p. 1.

<sup>975</sup> Chowdary (ed.), *Healthcare Sector*, p. 131.

buying medical technologies. On the other hand, there was no shortage of patients in need of those drugs and devices.

### **c. The Effects of Cost and Complexity of Medical Technology**

The cost and complexity of medical technology was a determining factor for each culture in its adoption of various tools of medicine. The medical device and equipment arena was improving, but only in certain regions of India, and only in particular categories of equipment. Hence X-rays were readily available in towns and cities where there were high levels of wealth, but not in more resource-constrained areas.<sup>976</sup> Furthermore, innovations that required more maintenance diffused slower than less complex technology. For instance, India saw the diffusion of more than 30,000 X-ray machines around the country, primarily because they were relatively cheap and easy to maintain.<sup>977</sup> But technology that was more expensive and difficult to maintain technology was in short supply: in 1990, for example, there were approximately 120 CT scanners, 5 MRI machines, and only a few dozen Gamma cameras in India.<sup>978</sup> The total spending in India for medical devices and equipment in 1990 was only \$60 million USD as a whole, compared to nearly \$2 billion USD in the U.S. and \$1 billion USD in Japan, countries with populations of roughly one-third and one-tenth that of India respectively.<sup>979</sup>

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<sup>976</sup> Mahal, 'Diffusion of Diagnostic Medical Devices and Policy Implications for India', p. 201.

<sup>977</sup> Sachidananda, 'National vs. International', p. 15.

<sup>978</sup> *ibid.*

<sup>979</sup> *ibid.*

<u>Rank</u>	<u>Company</u>	<u>No. of Product</u>	<u>Value (Rs. Millions)</u>	<u>Market Share</u>
1.	Glaxo Pharma	116	187	5.5
2	Ranbaxy	42	129	3.8
3	Cadila Labs	135	129	3.8
4	CIPLA	79	98	2.9
5	Alembic	68	97	2.8
6	Ambalal Sarabhai	138	91	2.6
7	Pfizer	35	90	2.6
8	Hoechst	44	89	2.6
9	Lupin Labs	63	88	2.6
10	Boots	38	79	2.3
11	Burroughs Wellcome	54	75	2.2
12	Parke Davis	88	68	2.0
13	Torrent Pharma	98	67	2.0
14	Eskayef	63	50	1.5
15	Rhone-Poulenc	50	50	1.4
16	Hindustan Ciba Geigy	43	49	1.4
17	E. Merck	27	48	1.4
18	German Remedies	71	47	1.4
19	Wockhardt	68	46	1.3
20	Fulford India	29	46	1.3
	<b>Total Market</b>	<b>5,748</b>	<b>3,424</b>	<b>100.00</b>

*Source: Jay Narayan Vyas, et al. (ed.), Pharmaceutical Data Book, 1993, p. 4*

Table 23: Top 20 Pharmaceutical Companies in 1992<sup>980</sup>

However, the growth of the Indian medical technology export market was not without complications. In 1985 to 1991, governmental regulations for the domestic production and sale of both pharmaceutical and medical device technologies increased dramatically.<sup>981</sup> Then, in June 1991, the U.S. pharmaceutical lobby prompted the U.S. trade representative to threaten the

<sup>980</sup> G. Felker, S. Chaudhuri, and K. György, *The Pharmaceutical Industry in India and Hungary: Policies, Institutions, and Technological Development* (Vol. 392) (Washington, D.C.: World Bank Publications, 1997), p. 10.

<sup>981</sup> K. Ekelman (ed.), *New Medical Devices: Invention, Development, and Use* (Washington D.C., 1988), p. 44.

Indian government over intellectual property violations related to the sale of generic drugs to U.S. pharmacies.<sup>982</sup> This threat was an early stage attempt to stem the production of cheaper copies of extremely profitable U.S. drugs and was only the beginning of what would become a substantial conflict between multinational drug companies and the quickly growing generics industry. Furthermore, a 1986 study by the United States Office of Technology Assessment found that increased regulatory efforts on X-ray devices, particularly produced by smaller companies, led to a reduction in new products innovations.<sup>983</sup> The increased regulations required new investments, both in people and process.

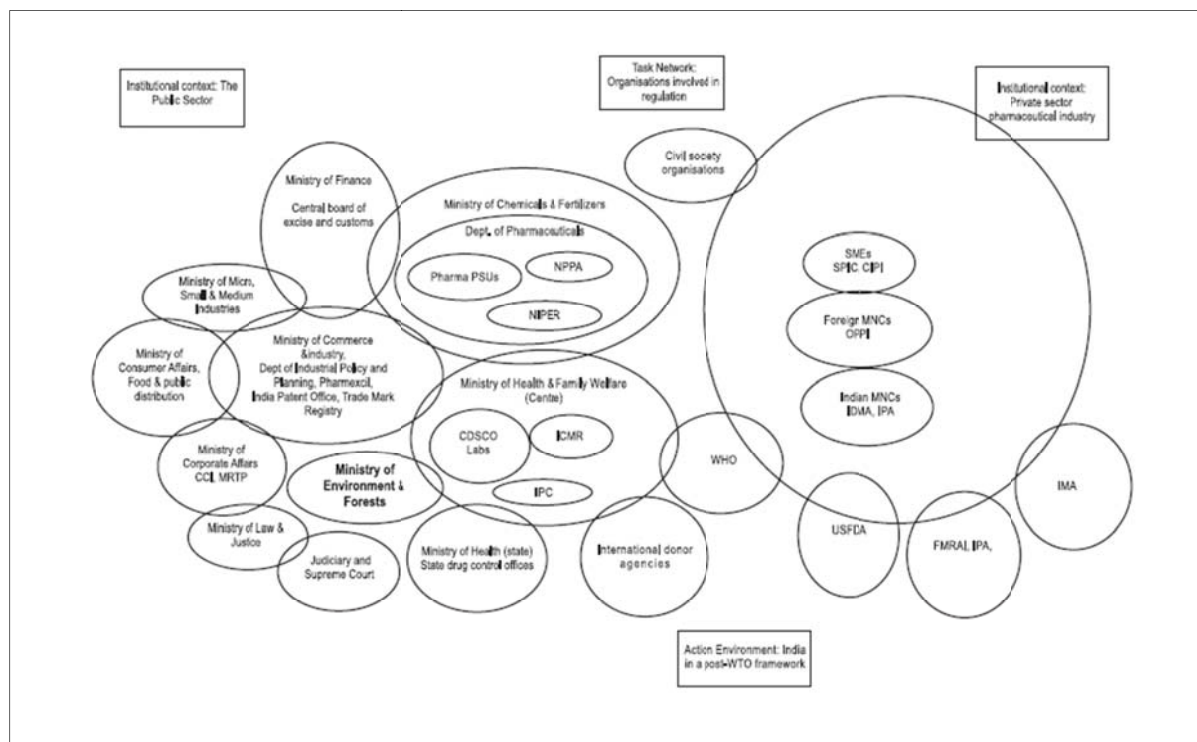


Figure 9: An organization chart of India's regulatory environment<sup>984</sup>

<sup>982</sup> A. Viswanathan, 'Special 301: Behind the US Threat', *Times of India*, 20 June 1991, p. 10.

<sup>983</sup> *ibid.*

<sup>984</sup> R. Jeffery and M.R. Santhosh, 'Architecture of Drug Regulation in India', *Journal of Health Studies* (2009), p. 16.

#### IV. India's Relationship with the Union of Soviet Socialist Republics (USSR)

As already discussed in previous chapters, the relationship between the Soviet Union and India was centred on India's nonaligned movement. In 1985, the Soviet Union was India's largest trading partner.<sup>985</sup> India imported roughly 70 per cent of its military arms from the Soviet Union.<sup>986</sup> And whilst India was ideologically unaligned with the Soviets, the two economies were very closely aligned. This section will therefore discuss India's relationship with the USSR.

Despite being nonaligned, India favoured Soviet technology transfer. This was due to better terms for financial assistance, the availability of pharmaceuticals and drugs plant designs, and the Soviet Union's willingness to completely transfer the intellectual property for manufacturing processes to India.<sup>987</sup> Foreign firms might have transferred technology only through foreign investment in India, which would have permitted them to maintain control. India's collaboration with the USSR allowed it to break the monopolies of transnational firms in the Indian market.<sup>988</sup>

Therefore, India chose to collaborate with the USSR to develop technology, even though it knew that Soviet technology was 'second best.'<sup>989</sup> Indians had documented evidence that the technology was of inferior quality to that of technologies from the West. The question of quality was even noted in section 9.41 of the seventh five-year plan, published by Rajiv Gandhi's government.<sup>990</sup> Whilst India saw the considerable advantages to be gained by working with the Soviets to directly acquire intellectual property from which they could subsequently produce drugs without royalties, they also clearly recognized that there was a quality gap to be closed.

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<sup>985</sup> A.I. Singh, 'The Soviet Union and India: A Bibliographical Review of Writing in English', *Journal of Communist Studies*, (4) 3 (2007), p. 311; S.K. Mehrotra, *India and the Soviet Union: Trade and Technology Transfer*, No. 73 (New York, 1990), p. 187.

<sup>986</sup> Singh, 'The Soviet Union and India', p. 311.

<sup>987</sup> Mehrotra, *India and the Soviet Union: Trade and Technology Transfer*, pp. 122–3.

<sup>988</sup> *ibid.*, p. 129.

<sup>989</sup> *ibid.*, p. 123.

<sup>990</sup> India's Planning Commission, *Seventh Five-Year Plan, 1985–90 Mid-Term Appraisal*.

India's trade statistics with the Soviet Union detail the extent of the medical technology trade relationship between the two nations, which grew by 800 per cent from 1970 to 1984.<sup>991</sup> In fact, the Soviet share continued to grow as the total number of Soviet purchases from India increased 600 per cent from roughly \$20 million USD in 1988 to over \$150 million USD in 1990.<sup>992</sup> Thus, the impact of the Soviet Union's collapse on the overall Indian economy was substantial, with roughly a fifth of India's trade value disappearing within a matter of roughly five years.<sup>993</sup>

The significance of the Soviet Union to India is also highlighted by other trade statistics. From 1985-91, the percentage of total trade with the Soviet Union and much of Eastern Europe did not dramatically change from previous years. In the period 1970-1 to 1985-6, the percentage of the total value of trade to the Soviet Bloc nations went from 21.1 per cent to 21.2, peaking at 25.3 in 1981-2, from an all-time low of 13.1 in 1979-80.<sup>994</sup> Comparatively, trade with the Organisation for Economic Co-operation and Development (OECD), a group of predominantly Western companies, received 50.1 per cent of India's export trade from 1970-1 and 51.5 per cent in 1985-6. In comparison, India's trade with LDCs (Less Developed Countries) increased from 19.2 per cent in 1970-1 to 14.7 per cent in 1985-6.<sup>995</sup> India clearly understood the growth markets for its medical technologies, and it was able to expand its market and profits in the LDC dramatically over the course of the 1970s and much of the 1980s. This would prove crucial to the survival of India's medical technology complex and export markets as the Soviet economy collapsed.

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<sup>991</sup> Mehrotra, *India and the Soviet Union*, p. 177.

<sup>992</sup> Indian Institute of Food Technologists, *Pharmaceuticals: A Sector Study Summary* (1991), p. 35.

<sup>993</sup> Mehrotra, *India and the Soviet Union*, pp. 122-3.

<sup>994</sup> *ibid.*, p. 31.

<sup>995</sup> *ibid.*

## V. Liberalisation and Transforming Alliances after the Economic Crisis of 1991 and the Fall of the Soviet Union

Despite liberalisation reforms and impressive growth in the 1980s, India faced an economic crisis in 1991, which stemmed from a variety of factors. First, there was the increase in world oil prices due to the conflict in the Persian Gulf.<sup>996</sup> Then, there was India's slow growth in important trading partners and a weak global export market. The world growth in exports decreased from 4.5 per cent in 1988 to 2.25 per cent in 1991.<sup>997</sup> There was also a lot of political uncertainty in India during this time, as discussed above. As a result, India's creditworthiness declined and international sources of commercial credit were cut off. Despite loans from the IMF, India's external liquidity position was extremely tight.<sup>998</sup>

Then, 'in December of 1991, as the world watched in amazement, the Soviet Union disintegrated into fifteen separate countries.'<sup>999</sup> Mikhail Gorbachev would be the Soviet Union's last leader. Although the world was surprised by the dissolution, the Soviet economy had stagnated in the 1980s: 'From 1981 through 1989, annual GDP growth lagged behind the rates reached in the 1960s and 1970s, but averaged 1.9 percent from 1981 to 1985, and later in the decade rose as high as 3.5 percent.'<sup>1000</sup> Furthermore, although 'the budget deficit was less than 2 percent of GDP in 1985' it grew to almost 9 percent by 1989.<sup>1001</sup> Arguably, India had more financial difficulties than the Soviet Union had in the late-1980s.<sup>1002</sup> However, India was not in a 'global superpower' competition with the United States, West Germany, North America, most of

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<sup>996</sup> V. Cerra and S.C. Saxena, 'What Caused the 1991 Currency Crisis in India?', *IMF Staff Papers*, 49(3) (2002), p. 403; 'India 1991 Country Economic Memorandum', *World Bank*, (Report No. 9412-IN, Vol. I) (23 August 1991), p. i.

<sup>997</sup> Cerra, 'What Caused the 1991 Currency Crisis?', p. 403.

<sup>998</sup> 'India 1991 Country Economic Memorandum', p. i.

<sup>999</sup> The Cold War Museum. Accessed 29 July 2014 at [www.coldwar.org/articles/90s/fall\\_of\\_the\\_soviet\\_union.asp](http://www.coldwar.org/articles/90s/fall_of_the_soviet_union.asp).

<sup>1000</sup> L.R. Aron, 'The "Mystery" of the Soviet Collapse', *Journal of Democracy*, 17 (2) (2006), p. 23.

<sup>1001</sup> *ibid.*

<sup>1002</sup> S. Kotkin, *Armageddon Averted: Soviet Collapse, 1970–2000* (New Delhi, 2008), p. 19.

the E.U., and Japan. The collapse of the Soviet Union was viewed as a victory by the free Western nations: Capitalism had won the struggle against socialism and a battle of superpowers that had been going on since the end of WW II came to a close. Global politics were profoundly changed as countries realigned to form new alliances and trade relationships.

The overall effect of the events of 1991 on the Indian economy was enormous. Firstly, there was a hole left in India's balance sheet by the dissolution of arguably its most important trading partner. The Indian medical technology complex had to find new sources of revenue to replace the revenue lost. Secondly, as the ruble devalued substantially relative to the rupee, medical technology companies, banks, and state governments were facing a devalued currency.<sup>1003</sup> And finally, the technology transfer process that was mimicked from the Soviet Union was becoming less attractive to the Indians as their markets with the West were expanding, in view of the previous quality gap that. With a new global alignment thrust upon them, the leaders of the manufacturing and healthcare sectors in India were forced to either adapt or perish. The Indian government knew that adaptation to the new geopolitical environment was critical. As Prime Minister Atul Bihari Vajpayee said, 'The Cold War moulds have been broken and this has enabled us to strengthen our links without ideological barriers.' India needed to reshape itself quickly, and reshape itself it did.<sup>1004</sup>

India moved toward a more complete version of liberalisation. This would mainly be accomplished with the release of the 'Statement of Industrial Policy, July 24, 1991', frequently called the New Industrial Policy.<sup>1005</sup> The policy ended many public-sector monopolies and 'initiated a policy of automatic approval for foreign direct investment up to 51 per cent.'<sup>1006</sup> The

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<sup>1003</sup> Mehrotra, *India and the Soviet Union*, p. 146.

<sup>1004</sup> F. Yahya, 'India and Southeast Asia: Revisited', *Contemporary Southeast Asia*, (25) 1 (2003), p. 79.

<sup>1005</sup> Panagariya, 'The Triumph of India's Market Reforms', p. 13.

<sup>1006</sup> *ibid.*

New Industrial Policy also ended investment licensing and industry entry restrictions.<sup>1007</sup>

Investment licensing meant ‘firms had to have an investment license before they could approach the import-licensing authority for machinery and raw-material imports.’<sup>1008</sup> Unlike the piecemeal reforms of the 1980s, this policy was a lot more effective in liberalising India.<sup>1009</sup> In addition, Prime Minister Manmohan Singh, who was appointed finance minister in 1991 by Prime Minister Rao, implemented major structural reforms to further liberalise most of India’s economy.<sup>1010</sup> Singh also secured the latest International Monetary Fund loans in January 1990.<sup>1011</sup>

Given the void in international trade left by the decline of the Soviet Union, the Indian government was compelled to look beyond the United States, Great Britain, and other large Western economies. In fact, in a paper written for the *Journal of Developing Societies*, M.C. Bhatt, a researcher for the Indian Council for Research on International Economic Relations, outlined a series of mechanisms through which various entities within India and Canada were able to create commercial agreements, including ‘...Joint ventures, Licensing agreement, Management agreement, Turn-key agreement, Acquisition of machinery and software, Leasing, Consortia, Contracts with a middleman, Technical assistance, Sub-contracting’.<sup>1012</sup> Bhatt’s article was in essence a ‘how-to guide’ on doing business across a number of different industries and allowing the dissemination of commercial ties to have occurred between the two countries. It was clearly aimed at North American businesses as a tool to increase foreign direct investments to India at the outset of 1990s.

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<sup>1007</sup> A. Panagariya, *India: The Emerging Giant* (New Delhi, 2008), p. 103.

<sup>1008</sup> Panagariya, ‘The Triumph of India’s Market Reforms’, p. 8.

<sup>1009</sup> Panagariya, *India: The Emerging Giant*, p. 103.

<sup>1010</sup> Chowdhury, *The New India*, p. 2

<sup>1011</sup> ‘Manmohan Favours Structural Reform’, *Times of India*, 6 July 1991, p. 1.

<sup>1012</sup> M.C. Bhatt, ‘Canada-India Investment of Promotion and Transfer of Technology with Special Reference to the Role of Joint Ventures in Retrospect and Prospect’, *Journal of Developing Societies* (7), p. 123.

Nonalignment had been one of India's key components of growth and foreign aid over the previous 60 years due to the competing economic partners between the Western nations and Communist nations. The nonaligned policy had helped India receive foreign aid from both the West and the Soviets over the course of the 1950s, '60s and '70s. Now that the threat of India moving toward communism had diminished, there was a possibility that Western foundations, governments, and multilateral agencies might substantially reduce support to India. However, events did not transpire in that way. The nonaligned strategy that many felt relied upon a polarized geo-political world was even more effective in the 'new world order.'<sup>1013</sup>

The West came to the aid of the world's largest democracy to ensure that its social stability was not affected as a result of either the global financial crises or the collapse of the Soviet Union. In fact, the archives of several multilateral agencies, including UNICEF, the World Bank, and the International Monetary Fund, make it clear that their financial support of various Indian programs increased even further.<sup>1014</sup> By 1991, UNICEF was providing \$175 million to India for maternal and child healthcare programmes, up nearly 100 per cent from 1981.<sup>1015</sup> The World Bank, for its part, increased loans to India from 1985 to 1991 as a means of stabilizing its currency. And in the case of the International Monetary Fund, it was the continued cash payments and consultations aimed at privatizing the economy and helping offset the economic contraction that followed the Soviet collapse.<sup>1016</sup>

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<sup>1013</sup> A. Evans, 'Forecasting India's Potential', *The Round Table*, 93 (376) (2004), p. 596.

<sup>1014</sup> Archives of the International Monetary Fund, Washington, DC, EBS/81/198, p. 3.

<sup>1015</sup> 'UNICEF United Nations Children Fund', UNICEF Annual Report 1986 (1987), p. 34. Accessed at [www.unicef.org/about/history/index\\_annualreports.html](http://www.unicef.org/about/history/index_annualreports.html).

<sup>1016</sup> R. Kohli, 'Capital Flows and Their Macroeconomic Effects in India', *International Monetary Fund Working Paper*, WP/01/192 (November 2001), p. 4.

## **VI. Conclusion**

The medical technology complex in India was able to continue its rich and trusted relationships with all the emerging markets in the world, most of which it had developed through its relationships with both the Commonwealth and the communist nations. The medical technology complex was also able to move quickly to shore up its ties with the multinational corporations that had developed operations in the subcontinent during the 1950s and '60s, many of which had ties to non-resident Indians working overseas. India's policy-making versatility, i.e. the success of the five-year plans and liberalisation reforms, saved a country that was on the brink in the early-1980s.

Chapter 7 has provided a number of new insights into the mobility and velocity of India's ability to adapt to changes in both the geo-political and economic environments. Beginning with the pre-liberalisation movement in 1985, India was able to once again show that it could move quickly toward changing a government policy of central planning toward privatization. The pre-liberalisation efforts demonstrated that growth could be achieved and that outcomes were positive. During this period, the country's national economic psyche began to shift from agricultural to automotive industries. This change alone might have caused enormous social disruption, and was swiftly followed by the decline of the Soviet Union, India's largest trading partner. However, since the tumultuous months following independence in 1947, the nation had been able to adapt its policies in order to both maintain its social stability and move into a period of high growth unmatched by any other major economy in the world, with the exception of China.<sup>1017</sup>

The dissolution of the Soviet Union and Eastern Bloc had many effects on the Indian economy. It required adept cash flow management in order to assure that the ruble exchange rate

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<sup>1017</sup> J.B. DeLong, 'India Since Independence: An Analytic Growth Narrative', p. 204.

did not affect reserves within the Indian banking system. It required the Indian medical technology complex to look for new trading partners to find technologies and resources that could compete in a more open global market. It required that the Indian pharmaceutical, medical device, and medical supply sectors find new customers to provide the revenue once taken up by the Soviet Union. But there was a silver lining to this cloud. As the liberalisation movement began in the 1980s and expanded massively in 1991, the Indian medical technology complex was able to capitalize. Fortunately for the leadership of these medical technology companies, the foundation of education, financing, and business networks had been laid through the 1950s, '60s, and '70s, so that they were well prepared to adapt to this new global healthcare climate. It was possible for them to imagine how they might engage with new potential research partners, customers, and distribution suppliers. Thus, it was the legacy of historical activity that provided the Indian medical technology complex with its competitive advantage over other countries, allowing it to thrive and adapt to what would otherwise be considered dire circumstances.

One of the other significant aspects of the period under review was the emergence of a medical technology complex within the public sphere. As noted early in the chapter, the Indian press, as well as its citizens, were simultaneously hopeful about the spread of Western science and technology in medicine, and critical of some of the risks and ethics regarding its use and testing. This was the case whether discussion centred on the newest pharmaceutical technologies available in the marketplace or medical devices to diagnose disease. Arguably, India was beginning to feel that it was competing with the global powers in the area of medical technology.

The period from 1985 through 1991 concluded with the approval of economic reforms on July 24, 1991. The near complete liberalisation of the Indian economy, and in particular its medical technology complex, became the launch pad of India's new economic regime, moving

the country toward global medical power status. India's medical technology complex was well positioned to take advantage of its tremendous natural resources, an industrial base created by the centralized planning doctrines of successive Indian governments through the second half of the twentieth century, and a rigorous educational system that had been developed over the previous 50 years.

The medical technology base that had been laid in the first 44 years of India's post-colonial history was extraordinary. Its medicines, devices, and supplies were high in quality, allowing India to compete with other global powers in medicines and medical devices. Thus, when regulatory and financial constraints were dissolved in July 1991, India's medical technology sector was as prepared as any other to compete on the international stage. The end result was that over the next twenty years, the medical technology sector would become the fastest growing component of the Indian economy.<sup>1018</sup>

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<sup>1018</sup> S. Mani, 'Has India Become More Innovative Since 1991? Analysis of the Evidence and Some Disquieting Features', Working Paper 415 (2009), pp. 44–45. Accessed at [http://opendocs.ids.ac.uk/opendocs/handle/123456789/3132#.U0wPeiLD\\_ct](http://opendocs.ids.ac.uk/opendocs/handle/123456789/3132#.U0wPeiLD_ct).

## **Conclusion: Medical Technology, International Assistance, and India's Role in Global Health**

‘No future is certain. But India seems to be on the side of history.’<sup>1019</sup>

Between 1947 and 1991, India not only became effective in spreading medical technology within its own country, as with the smallpox vaccination campaign, but also became a global supplier of medical technology. Indian leadership, via a strong industrial growth initiative, bold domestic policy moves like the Patents Act of 1970, and a non-aligned foreign policy, guided a country on the brink of collapse in 1947 to become one of the most influential medical technology centres in the world. In addition to its own efforts, India's predominantly free-market democracy received substantial aid from multilateral organizations and private foundations abroad. These grants were critical to India's medical technology growth and its ability to improve mortality rates and life-expectancy. This conclusion will provide the final analysis of this work, delineating the steps, both opportunistic and pragmatic, that India took to become a global power in medical technology.

The key concept in this thesis has been the Medical Technology Complex (MTC), which consists of governments, foundations, corporations, and missions with varied agendas but the same goal. Table 24 shows members of the MTC in India: all of these institutions have at their root a common aim: to help diagnose, treat, and manage disease amongst large groups of people. Although all of the individual actors need to be self-sustainable, only a few of them are for-profit actors in the larger healthcare ecosystem. Furthermore, these stakeholders actively participate in the development, production, distribution, and administration of medical technology to people around the world.

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<sup>1019</sup> A. Evans, ‘Forecasting India's potential’, *The Round Table*, 93 (376) (2004), p. 596.

<b>Stakeholders</b>	<b>Examples</b>
Governments	United Kingdom, United States, other commonwealth countries
Multilateral Agencies	United Nations, WHO, World Bank
Foundations	Rockefeller, Gates, and Ford
Corporations	Merck, Siemens
Religious Groups	SPG, Catholic Church
Non-profit Groups	Doctors Without Borders, American Red Cross

*Table 24: List of MTC Stakeholders*

## **I. Growth of the Medical Technology Complex in India**

As we saw in the early part of this work, there was a limited medical technology presence in pre-independence India. However, it was primarily developed as a means of supporting medical technology for the British military, a trend that lasted from the late nineteenth century through to World War II. This technology was embryonic at best, predominately supplying the British military with drugs, vaccines, and some medical supplies. Medical technology and supplies in India at that time was generally supplied by the colonial government, imperial military, and medical missionaries. These three stakeholders did not meet the minimum threshold of five individual actors required to meet the definition of the MTC. However, key elements of the MTC, including international scientific connections and the growth of educational institutions, were beginning to form and remained intact after the colonial era to contribute to the formation of a true MTC in India.

The development of medical technology in India occurred over a significant period of time. It was aided by a combination of both the federal government's strong central planning drive, encapsulated in its five-year plans, and India's nonaligned foreign policy. The complex in

India was almost non-existent in the 1940s and '50s. As outlined in Chapters 2 and 3, the Indian government had to balance the freedoms of democracy and speech with the need to feed its population. India's first two five-year plans were primarily focused on establishing the agricultural and industrial base through a mix of free market and state controlled financing. As we saw in Chapters 3 and 4, the emerging medical complex consisted of rudimentary factories and medical device shops that had previously served the colonial military and government. However, this situation slowly changed: not only were governmental regulations relaxed, but the government also began funding medical education during the 1950s and '60s. The third and fourth five-year plans, in particular, focused on the larger social and healthcare issues of the country.

The coming of the Cold War, and the multidimensional competition between the Soviet Union and the West, made India one of the top global battlefields in a largely ideological war. With the 'fall' of China to communism, the West became even more motivated to prevent other nations from embracing communism, especially one of the world's most populous nations. Western infusions of funding for factories that produced vaccinations and other medical technologies, as well as educational and infrastructure grants for hospitals and medical schools, were a direct result of the Cold War, as we saw in Chapters 4 and 5.

The political left was nevertheless critical to the internal development of India's medical technology. Throughout the 1950s and 1960s, the government made attempts to change its patent laws, seeking a way for widely used medications to be manufactured at home at a lower cost. By the mid-1960s, and as the Indian electorate moved to the left, protests regarding the inequity of the Indian healthcare system mounted. The most obvious, or at least the loudest, of the mounting criticisms related to the ability to cheaply manufacture and distribute pills to treat the country's

most common diseases, including malaria and general infections. This also included a growing list of vaccinations that were available in Western countries for mumps, measles, and rubella. It was this push to the left that moved the world's largest democracy to initiate innovative reforms that enabled it to revolutionize the production of medical technologies.

As public health emerged as a topic for debate in both democratic and communist countries, the need to supply populations with new life-saving technologies grew exponentially. The Indian government was finally able to reform its patent laws with the Patents Act of 1970. It was the Patents Act that truly birthed an indigenous MTC in India. As detailed in Chapter 5, the Patents Act redefined what types of technology could be patented. Whilst the international intellectual property community defined the patent as the ingredients or the substance of the pill or device, India modified the definition so that it covered only the process through which the pill or device was manufactured. This policy innovation enabled India to mass produce dozens of high volume drugs and devices that had once been prohibitively expensive. As we saw in Chapter 6, the Act began to attract funding that was necessary for the country's long term growth in medical technology development, production, and distribution.

Investment in India grew substantially post-1970, as did the nation's medical technology and pharmaceutical exports. Aside from the Soviet Union, which was a massive export partner in this area, more than two dozen other countries purchased huge amounts of medical technologies from India during the 1970s. India began to supply medical technology to most of the communist countries around the world, including the Soviet Union itself, Czechoslovakia, and Romania. Moreover, whilst the resource-constrained nations of the 'global south' were trying to find new sources of cheap vaccinations and antibiotics, higher resource countries in North America, Asia, and the EU were suffering from extremely high healthcare costs, forcing them to turn to India for

cheaper medical supplies and medications. Moreover, whilst Western nations may have officially opposed India's patent reform, they remained committed to maintaining India as a democracy, which committed them to continuing aid and other forms of financial support. Thus, the transition from a largely secondary market supplier to a primary market supplier provided India with another opportunity to pivot itself into new sustainability.

Whilst the Patents Act of 1970 was a critical juncture for the development of medical technology in India, the pre-liberalisation reforms of the mid- to late-1980s also had a substantial impact. In 1984, the administration of Rajiv Gandhi pursued an agenda of growth that created a number of private sector opportunities in industries previously controlled by the government. The growth of medical technology following the Patents Act was further accelerated as for-profit investment groups saw an opportunity to take ownership of India's nascent medical technology. India thus became a producer of high quality, low cost medical technology. When corporations, foundations, multilateral agencies, or other countries needed large quantities of drugs, devices, or supplies, they turned to India.

Coming through the transition decade of the 1980s, marked by early liberalisation movements and the transition from a Soviet dominated market, the stepped-up liberalisation efforts in 1991 meant that the face of India's medical technology would change forever. The Indian policy of non-alignment would be tested as the Soviet economy began to spiral downward. As the Soviets represented roughly 25 per cent of the Indian export market in medical technologies, their collapse in the mid- late-1980s presented a serious challenge to India's medical technology leaders. Finding new markets and transitioning from the communist leaning nations to free market democracies became a major sustainability issue. By 1989, India had been able to transition most of its excess capacity to new market sources. The liberalisation

movement in the 1980s had opened roughly 20 per cent of the economy to free market investments; further reforms in 1991 expanded those investments to nearly 80 per cent. Liberalisation provided enormous opportunities for free market investment and drew massive amounts of foreign direct investment. The effect of this on the growth of medical technology was massive. It cemented India's leadership role in the development, production, and distribution of medical technologies. By the twenty-first century, India's research and manufacturing activities had become significant around the world, in large part due to the excellent quality-to-cost ratio of its pills, devices, and supplies.

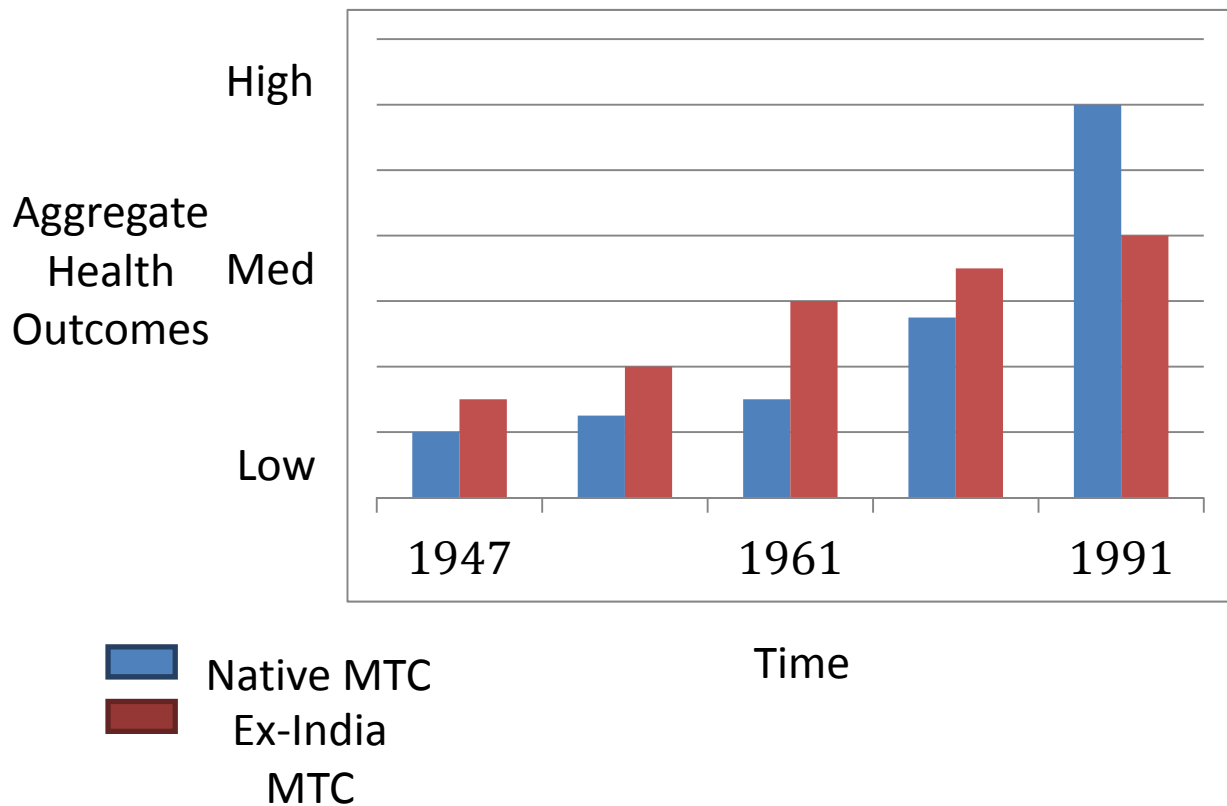


Figure 10: Growth of Medical Technology in India with the Aid of the Stakeholders that are part of the MTC

## II. The Role of Foreign Policy, Nature, Education, Patent Law, and Market Demand

One of the overarching themes of the first fifty years of India's independence, and the corresponding growth of medical technology, was the country's ability to respond to the needs of its population. Whether it was the disintegration of the country during the Partition that followed independence or the near-collapse of India's currency in the 1970s and 1980s, the nation's institutions were able to respond to each crisis in turn. India's foreign policy, natural resources, the education programme of the 1960s, the regulatory shift of the 1970 Patents Act, and the free market reforms of 1991 placed the country in an advantageous position to enter the global MTC. These factors converging together proved to be the fundamental building blocks of an ecosystem that not only rewarded the hard work of tens of thousands of leaders in this area, but also provided an attractive economic base for tens of millions of workers.

The development of medical technology in India was initially met with local resistance to Western medicine. We saw evidence of this in Chapter 3's discussion of medical missionaries and their use of eyeglasses. In Chapter 4, we examined the backlash toward Western medicine and technology, the eventual inclusion of Ayurveda and other traditional Indian medicines, and the registration and certification of the Indian Medical Council. The distaste for Western technology was well documented in Faisal Devji's book, *The Impossible Indian*, which quoted Gandhi's critique of Western medicine.<sup>1020</sup> However, India was able to overcome this internal challenge, reaching a turning point with the eradication of smallpox detailed in Chapter 6. The development of medical technology in India thus enabled the country's population accept mass immunization and other Western technologies.

Once Western medical technology was accepted on a large scale, India's staunch maintenance of an open and free society had two major consequences for medical technology

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<sup>1020</sup> F. Devji, *The Impossible Indian: Gandhi and the Temptation of Violence* (Cambridge, 2012), p. 185.

development. The first was that it provided a viable economic environment for the development of new products and services. The second was that, for the most part, India's inventors, physicians, and scientists remained in the country to continue their creative work in medical technology advancement, thus avoiding the brain drain that afflicted many other developing nations.

In addition to its people, the natural resources that were indigenous to the subcontinent were important to the development of medical technology in India. These resources were essential to the growth of medical technology after independence. India's key natural resources included the water required for the cooling process in the manufacture of stainless steel; abundant sand in the hills and shorelines of the country, a critical ingredient for manufacturing glass, which in turn supported the research for blood collection technologies, research laboratories, and vaccination bottles; and a variety of plant species containing curative elements that were absolutely critical for the growth of medical technology in India. All of these natural resources allowed for the MTC to develop without mass imports from other areas of the world.

In the 1950s, as shown in Chapters 3 and 4, one of the key drivers of growth was the emergence of a state controlled economic development plan. The adoption of the Soviet-style five-year plan model allowed India to embrace aspects of the centralized economic development policy of the communist nations whilst largely remaining a free market democracy. The first two five-year plans developed the agricultural infrastructure that was needed to avert future famines. They also allowed the construction of factories and other manufacturing resources necessary to create the machinery and resources required to build more factories and infrastructure. The IIT educational system supplied India with the world-class engineers needed to support these ambitions. Finally, we saw that the free labour market remained intact, which enabled the large-

scale production of roads, factories, and buildings at a rapid pace. By the end of the 1950s, India had created an agricultural and manufacturing base strong enough to support further development, whilst averting what had become nearly epidemic famines.

Also crucial to India's emergence as a medical technology giant was the evolution of its educational culture from the mid-1950s. Educational reform began with the establishment of the first IIT and AIIMS, and continued through to the late-1980s as pre-liberalisation policies brought about an explosion in educational institutions. India's educational base provided a self-sustaining structure of intellectual resources to match the nation's abundant natural resources. Ultimately, technology is the manifestation and the application of science in society; India's commitment to science and engineering paved the way for the extraordinary growth of the medical technology through to 1991.

The impact of education can also be seen in other areas. Medical technologies, unlike many other technologies in consumer electronics or telecommunications, require a large number of technicians for their implementation. In India, as elsewhere, the administration of vaccines during the smallpox eradication programme was carried out by hundreds of thousands of specially trained public health workers. Without an educated population to perform these injections, the diffusion of medical technology would have been nearly impossible. India had a well-trained population of public health workers able to carry out such a large vaccination campaign. With this work, India's people supported the further development and production of medical technologies in domestic markets.

The role that market demand played in the emergence of India's medical technology was significantly helped by various global efforts in public health. The expansion of human rights after World War II, which extended to healthcare just as much as free speech, freedom from fear,

and the freedom to vote, was one of the final building blocks of democracy. This element of social justice helped elevate healthcare from something once considered a luxury to an aspect of human being every bit as essential as education or nutrition. As democracies increased in size and scope throughout the latter half of the twentieth century, so did the demand for medical supplies. By the end of the twentieth century, a massive global demand for basic medicines and medical devices was created by the needs of not only the world's top twenty economies, but all of the world's nations. But there were limited budgets to pay for this demand, which created an opportunity for India to produce these medical technologies at a cost that developing countries and their cost-conscious healthcare systems could afford.

The economic expansion that followed India's patent reform pointed to the existence of real and sustainable market demand, both domestically and internationally, for medical technology. We saw how the size of India's domestic population created easy profits for investors, which the government could use to rationalize funding self-sufficient vaccination plants. India's domestic market allowed it to create central government and private sector opportunities for medical technology production. These opportunities could not exist in smaller developing countries. Following the Patents Act, moreover, India developed an effective distribution network within the communist-leaning countries, expanding its development and production facilities dramatically. As we saw in Chapter 7, the Soviet Union, most of Eastern Europe, and many countries in Africa, Asia, and Latin America bought high-quality medications and technologies from India at markedly reduced prices. India's ability to transition to a secondary market proved an important factor in the growth of its medical technology through the 1970s and into the '80s.

One of the key aspects of the development of medical technology in India was the diffusion of technologies. The diffusion of medicines, medical devices and medical supplies was related to the elements of education, patents, foreign policy, natural resources and market demand. Had it not been for each one of these five critical elements, the development of medical technology in India could never have occurred. Nothing represented diffusion better than the eradication of smallpox, an effort that required hundreds of thousands of health workers, a complete redesign of the vaccination needle for smallpox, massive marketing campaigns, and enormous funding sources that included an infrastructure for producing the smallpox vaccines well below market costs. The diffusion of smallpox technology has not only saved millions of lives since the 1960s, it has also saved tens of millions of Indians the pain and suffering of living with scarred bodies. The eradication of smallpox through the diffusion of technologies around the subcontinent indicated that it was possible to harness the power of medical technology to improve the greater good on a globally transformational level. The eradication of smallpox in India is a case study of how medical technology diffusion can occur even when political and social circumstances were not ideal.

The 1960s continued to demonstrate how India's innovative policy making helped the country as a whole, and especially the medical technology complex, grow. The innovative policy making extended from the partially state controlled economy to the foreign policy of non-alignment. This policy of non-alignment allowed India to remain a democracy whilst also maintaining close ties to the Soviet Union and communist-leaning countries, as well as the West. Non-alignment garnered India hundreds of millions of dollars in aid from both sides: the Soviets were building factories for the mass production of vaccinations, whilst the West invested hundreds of millions of dollars into new factories for the production of for-profit medicines.

These policies had an immeasurable impact on the growth of medical technology in India. In addition to the policy of non-alignment and a partially state controlled economy, the free labour policy remained intact, resulting in India being one of the more attractive democracies for investment.

The threat of war loomed throughout the 1960s, as the industrial base that had been developed in the 1950s continued to build massive amounts of military arms in preparation for potential wars with China or Pakistan. The medical technology sector continued to form, as evidenced in Chapters 4 and 5, as funding from multilateral, bilateral, and individual governments came into India as a means of attempting to influence its political leanings. The 1960s also saw an increase of corporate investment in medical technology on the subcontinent. Whilst other parts of Asia (such as Japan, South Korea, and Taiwan) saw significantly higher levels of foreign direct investment, India was still on the radar. Chapter 4 laid out the various corporate alliances that were made amongst Western medical device and pharmaceutical companies in order to take advantage of the largest free market in the world. The educational sector also continued to grow rapidly as the IIT expanded to several campuses across India.

Throughout the 1970s, India's natural resources continued to supply copious amounts of basic minerals and aquifers to manufacturers, key life sciences, and medical supplies. The number of ITTs continued to expand, whilst the number of medical schools and biomedical technology training schools increased as well. The 1970s proved to be the point at which India's global leadership in medical technology would become firmly implanted, and a point from which the country would never turn back.

Whilst the policy of non-alignment was still in play, India liberalized its economy, making it more attractive for foreign direct investment. As discussed, the liberalisation of the

1980s was only the beginning: by the end of the 1990s the process was virtually complete. However, even partial liberalisation of India's economic infrastructure drew enormous foreign direct investment to the country. This allowed medical technology in the 1980s to grow in even more ways than it had grown in the 1970s. The free labour markets were maintained, thus providing a globally competitive production environment. The educational systems in India continued to gain strength during the 1980s, particularly in medical technology, which provided the human capital needed for the foreign capital investment the country was seeing. Ultimately, the 1980s proved to be a significant decade in India's transition from not only secondary to primary markets, but also secondary to tertiary, as it would soon become the leader in supplying medical technologies to the world's poorest countries.

In retrospect, it seems as though India's commitment to a free market democracy and its will to survive any crisis, internal or external, allowed it to evolve and pivot itself with a level of agility that is truly extraordinary. This agile political movement was a critical element in harnessing the other variables of natural resources and political innovative policy making as well as advancing educational resources. The growth of medical technologies in India is as much a reflection of the nation as it is of each person within that nation. The most remarkable step in this evolutionary process was when India signed the TRIPS agreement in 2005, which 'closed the circle', as it were, as the nation that abandoned the international intellectual property law community 35 years earlier was once again a part of it.

One key question is why India, amongst all developing nations, emerged as a dominant provider of medical technologies in general, and biopharmaceuticals specifically. It is often asked why China, Turkey, or Egypt did not enjoy similar success at expanding their life science industries. As might be imagined, the answer involves a complex series of elements. The most

important factor was India's agile environment of policy formation and implementation, which in turn was a product of the country's democratic system of government. As a democracy, the government had to respond quickly to changes in popular opinion regarding national policies. The electorate had become dissatisfied with the progress in providing lifesaving pharmaceuticals, and in an effort to avoid social unrest, the Indian government responded with creative and rigorous policy changes. The results were the Drug Price Control Order and the Patents Act of 1970, as well as the move towards liberalization in the 1980s and in 1991. This sort of responsiveness is rare even for democracies, let alone autocratic governments. India's democracy was extraordinary, existing as it does under a sword of Damocles: the consequence of insufficient responsiveness is essentially national implosion, as happened in 1947.

Another important factor was the geopolitical situation in which India found itself. First, unlike China, India retained what was fundamentally a free-market economy: it was open and allowed economic actors to engage with external entities. Unlike these countries, India had ties to the research networks of the Commonwealth, and that network provided extraordinary scope for collaboration and exchange of ideas. Even prior to independence, India collaborated with foreign governments, foundations, and medical societies to find vaccines, treatments, and cures for tropical diseases. The effects of these relationships continued to grow after independence. The relationship India had with both Western and Commonwealth nations proved valuable in developing India's research and development capabilities.

Finally, no other developing nation received as much international aid as India did from 1950-1990. China had effectively sealed itself off from Western financial support (and due to the Sino-Soviet split, much Soviet support as well), whereas India's policy of non-alignment allowed it to court both East and West, thereby receiving hundreds of billions of dollars in aid over four

decades. Much of this aid was in the form of grants that allowed India's medical technology industry to form and grow. Foreign direct investment flowed in from the West, whilst Communist and less developed countries provided India with a market for pharmaceutical products beyond its own borders. The combination of domestic and export markets produced a market large enough to sustain an innovative pharmaceutical industry.

### **III. India 1991 to the Present**

Only fifty years ago, India was on the verge of implosion and had an average life expectancy of just thirty-three years. By 1991, it had become one of the leading developers and producers of new medicines for emerging economies around the world. This startling transformation can, in part, be explained by a series of bold policy moves that alienated India from many of its Western allies. In 2005, however, India's legislature voted to modify its patent structure to once again conform to international standards. By signing the Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement, India was brought back into concert with the rest of the world in regards to patent laws; companies would now have the same patent rights in India as in North America and the European Union.<sup>1021</sup> The decision to sign TRIPS was motivated by economic as well as diplomatic concerns. By 2005, the patents on medications and devices that India had infringed upon in the 1970s and 1980s had been moved to all-patent status, meaning that anyone was now free to use the technology, thereby resolving any potential international property laws it would have had with antibiotics, vaccines, and diagnostic devices.

Despite India's signing of the TRIPS agreement in 2005, many parts of the country still have an aversion to Western technology and medicine. The resistance to Western medical

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<sup>1021</sup> M.F. Collen, 'Origins of Medical Informatics', *Western Journal of Medicine*, 145 (6) (1986), p. 779. See also AMIA. Accessed at [www.amia.org/about-amia/science-informatics](http://www.amia.org/about-amia/science-informatics).

technology seen in the form of the Ayurvedic political movements during the 1950s and the smallpox eradication resistance witnessed in the late 1960s early 1970s are not entirely things of the past. Whilst India's population in general is accepting of technology, many people without a high school education remain resistant to common forms of medical technology. Interventions such as vaccinations, annual health screenings, and tuberculosis treatment are difficult to fulfil amongst a large number of the Indian population. Distrust still plagues much of the countryside and less educated urban populations. Hence, whilst the resistance to technology seen during and immediately after independence has declined significantly, remnants remain amongst a substantial part of Indian society.

Since 1991, India has not only increased its presence in the area of medicines, medical devices, and medical supplies, but it has also taken a leadership position in medicine during the age of information. This area of technology is known as medical informatics, which is the study of any medical data capture, storage, retrieval, and analysis. This growth is attributed to the convergence of information technology and software applications, as well as the growth of electronic health records and mobile applications. Medical informatics has developed in India because of the comparatively inexpensive cost of labour for software programmers in the country. The number of companies in India developing medical information systems for hospitals, physician offices, pharmaceutical companies, health insurance companies, and consumer applications on mobile phones has skyrocketed as these tools have become increasingly central to today's health systems.

For example, in recent years, the Wellcome Trust started funding a project called 'Affordable Healthcare in India.'<sup>1022</sup> The objective of this project is to 'fund translational research

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<sup>1022</sup> Wellcome Trust, Funding. Accessed 11 August 2014 at [www.wellcome.ac.uk/Funding/Innovations/Funded-projects/India/index.htm](http://www.wellcome.ac.uk/Funding/Innovations/Funded-projects/India/index.htm).

projects to deliver safe and effective healthcare products for India – and potentially other markets – at affordable costs.<sup>1023</sup> Some of the projects that have received funding are: ‘an integrated mhealth system for the prevention and care of chronic diseases’, ‘development of a rapid system for diagnosing corneal infections using pathogen-responsive polymers’, ‘affordable mechanical ventilation for emerging market’, ‘development and impact assessment of an mhealth package for rural India focusing on reproductive, maternal and child health’, ‘development of Smart Cane, an affordable above-knee obstacle detection and warning system for the visually impaired’, and ‘chest compression device for patients with sudden cardiac arrest.’<sup>1024</sup>

Another information technology area in which India excels is telemedicine, which is the use of information and communication technologies to diagnose patients remotely.<sup>1025</sup> It was first developed in Boston in 1972 to create a virtual physician’s examination between the Boston-Logan Airport and Brigham Women's Hospital in downtown Boston. India has been perfecting telemedicine for over 30 years and today uses telemedicine as a means of connecting clinics in Africa, the Middle East, and parts of Asia to its world-class hospitals in Delhi, Hyderabad, Mumbai, and many other cities.<sup>1026</sup> In 2009, for example, India signed an agreement to provide telemedicine services to Ethiopia, a country with a chronic shortage of physicians.<sup>1027</sup> The agreement served not only to improve relations between the two nations, but was also part of a trade agreement with the Ethiopian government.<sup>1028</sup>

Since 1991, India’s healthcare system has been able to provide cost-efficient ways to treat over a billion patients. One of the key elements of this success has been the implementation of

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<sup>1023</sup> *ibid.*

<sup>1024</sup> *ibid.*

<sup>1025</sup> E. Şenel, ‘History of Tele dermatology: A Technique of the Future in Dermatology’, *Skinmed*, 8 (3) (2010), p. 167.

<sup>1026</sup> *ibid.*, p. 168.

<sup>1027</sup> B. Malone, ‘“Telemedicine” Links Africans to Indian Expertise’, Reuters, 3 April 2008. Accessed at [www.reuters.com/article/2008/04/03/us-africa-india-hospitals-idUSL015117720080403](http://www.reuters.com/article/2008/04/03/us-africa-india-hospitals-idUSL015117720080403).

<sup>1028</sup> *ibid.*

vaccination-reminder programmes using text messaging and interactive voice-response systems. Initially launched in 2003, these programmes have grown substantially around all levels of government in India. The programmes have been supported with governmental funds, as well as funding from the WHO and the Gates Foundation. The programmes have been shown to not only be clinically effective in increasing vaccination rates for people all over India, but also very cost-effective, with text or interactive voice message costing just pennies to deliver.

Another indicator of the strength of the MTC in post-1991 India are the industry associations that have been formed within the country. One such example is the Indian Pharmaceutical Alliance (IPA), a professional association of pharmacists in India.<sup>1029</sup> The IPA has approximately 10,000 members and operates in through 17 state branches.<sup>1030</sup> In March 1999, after years of lobby by the US and other high resource countries, India finally passed legislation amending the Patents Act of 1970.<sup>1031</sup> The new law was a significant action that brought India's patent laws in line with international laws to comply with TRIPS.

Since 1991, the manufacturing sector has grown at such a pace that India is now one of the largest export countries for manufactured goods in the world. India produces everything from large construction vehicles to steel.<sup>1032</sup> Not only has this led to a boom in the construction of new buildings, it also led to a surge in growth manufacturing plants including those for medicines, medical devices, and medical supplies. Previously, India had to rely on obtaining much of its materials for constructing new plants from outside of India, including large vehicles for moving earth, making cement, and other key construction components. The nation now has the ability to build this all on its own.

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<sup>1029</sup> Indian Pharmaceutical Association. Accessed 11 August 2014 at <http://ipapharma.org/Home.aspx>.

<sup>1030</sup> *ibid.*

<sup>1031</sup> J.M. Mueller, 'The Tiger Awakens: the Tumultuous Transformation of India's Patent System and the Rise of Indian Pharmaceutical Innovation', *University of Pittsburgh Law Review*, 68 (3) (2007), pp. 491–641.

<sup>1032</sup> Here is a list of industries in India. India Brand Equity Foundation. Accessed at [www.ibef.org/industry.aspx](http://www.ibef.org/industry.aspx).

Though the Indian MTC has faced extraordinary challenges over the past decades, the net result has been the improvement of lives around the world. Whether gauze for wound care, glass containers for blood collection, or vaccinations for new-born children, India has supplied many of the world's resource constrained nations with access to fundamental healthcare technology that would otherwise be out of reach for those countries. The number of lives that have been saved is minimally estimated to be in the tens of millions, or more likely hundreds of millions.<sup>1033</sup>

It is no surprise that so many of organizations geared toward improving human healthcare around the world have turned to India. Their low-cost production model in life science technologies, medical devices, and medical supplies has enabled many of the world's leading foundations and non-profits to provide for low resource communities in ways that they previously could not. These industries included biomedical informatics, telemedicine, second opinion services, medical transcription services, medical billing services, and bioinformatics services. On the second opinion service side, physicians, radiologists, and laboratory technicians in India can now review data such as X-rays, CAT scans, and MRIs and provide physicians in the United States with additional diagnosis and analysis of that data. Whilst a physician in a developed country may garner upwards of ten thousand pounds a month in salary, a physician in India averages roughly fifteen hundred pounds a month. This cost savings has attracted enormous activity in this sector, resulting in significant growth since 1991.

Medical technology in India has achieved rampant growth over the past three decades. This expansion has continued due to the original variables laid out in the Introduction and discussed in this Conclusion, as well as the advent and implementation of the international fibre

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<sup>1033</sup> M. Khor, 'The Man Who Saved Millions with Cheap Medicines', *Third World Network*, August 2013. Accessed at [www.twinside.org.sg/twnf/2013/3985.htm](http://www.twinside.org.sg/twnf/2013/3985.htm).

optic cable laid deep in the ocean between continents.<sup>1034</sup> This telecommunications cable provided internet and voice access to billions of people around the world between 1994 and 1999. It allowed a host of new industries and businesses in India to support the research, development, and management of billions of transactions a day in the medical technology complex. In a model similar to second opinion services, telemedicine provides voice and video links to enable physicians from India to provide nuanced medical expertise in therapeutic areas such as neurology, cardiology, and orthopaedics to doctors around the world. Surgeries in these areas can become highly specialized and require an expert who has done an extraordinary volume of a particular procedure. Super-specialists in India have access to a billion patients, and therefore have a higher volume practice than traditional physicians in resource rich nations. Thus, telemedicine has become a new sector with high growth.

One way physicians from outside India have become more efficient in their daily activities, allowing for an increase in patient therapies, number of patients treated, and also physician resumes, is by using voice recordings to dictate their notes rather than typing out the detailed diagnoses and treatment plans in their electronic health records. Due to its large, well educated, and English speaking population, India has become the world leader for medical transcription services. The cost per word for these services in India sits far below any medical transcription service in a resource rich nation, savings that have created another high growth medical technology market. Advertisements for these services can be seen in various medical and trade journals, which typically have a sales and marketing department in developed countries, whilst the operations are entirely based in India.

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<sup>1034</sup> P. Wolcott and S.E. Goodman, 'Global Diffusion of the Internet-I: India: Is the Elephant Learning to Dance?', *Communications of the Association for Information Systems*, 11 (1) (2003), p. 596.

Another large growth area in India over the past three decades has been biomedical informatics. Due to its large computer science literate population, India is now the hub for developing and supporting the information technology applications that support hospitals, insurance companies, and life science companies in resource rich nations around the world. These companies include not only GE Health Systems, but also Allscripts, Cerner, and Athena Health. And those systems are only for all military and inpatient medical records systems. United Healthcare and Aetna also employ tens of thousands of developers, programmers, and systems engineers in India to support their medical information systems on a daily basis. The biotechnology, medical technology, and pharmaceutical markets operate on the same scale. Whether for research and development or design and creation, these firms require large amounts of information technology knowledge to model their products and analyse computational data sets. Genomic data, which yields extraordinary volume, requires significant expertise in order to properly interpret the results. India's highly trained work force and low cost of operations provide companies around the world with a unique opportunity to do more with less.

Over the past decade, a contest has emerged between China and India to become the preeminent medical technology provider in the region. Beginning in the late-1990s, China began to compete not only with the low cost of production offered within India, but also the level of quality. At a presentation made in Berlin in March 2009, Michael Chase-Ortiz discussed the key competitive differentiation points between India and China.<sup>1035</sup> He noted that India's pharmaceutical industry is the fourth largest in the world in terms of volume of medicines produced and thirteenth in terms of value, hovering around \$7 billion USD. China was from India by volume, but it is the ninth largest. In his presentation, Chase-Ortiz concluded that both countries' medical technology industries would continue to grow at a good pace, but that India

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<sup>1035</sup> M. Chase-Ortiz, *Pharma Sourcing from India and China* (Presentation in Berlin, 2009), p. 40.

would have to reconcile increased costs as materials imported from China become more expensive overtime and as China attempted to take business from India.

Despite the commercial explosion of medical technology in India over the past two decades, the research and development sector has not seen equivalent growth. Professor Xiaolan Fu has noted that India had the lowest combined spending on research and development, as a percent of GDP, in imported technology and domestic innovation in emerging markets that of the major economies in the world today. India also has the fewest number of researchers in terms of thousands of researchers per million. This is a troubling statistic, since research and development is a growth driver for economies in flux. The lack of investment does not bode well as a part of India’s overall medical technology foundation as it continues to compete and expand over the next two decades.

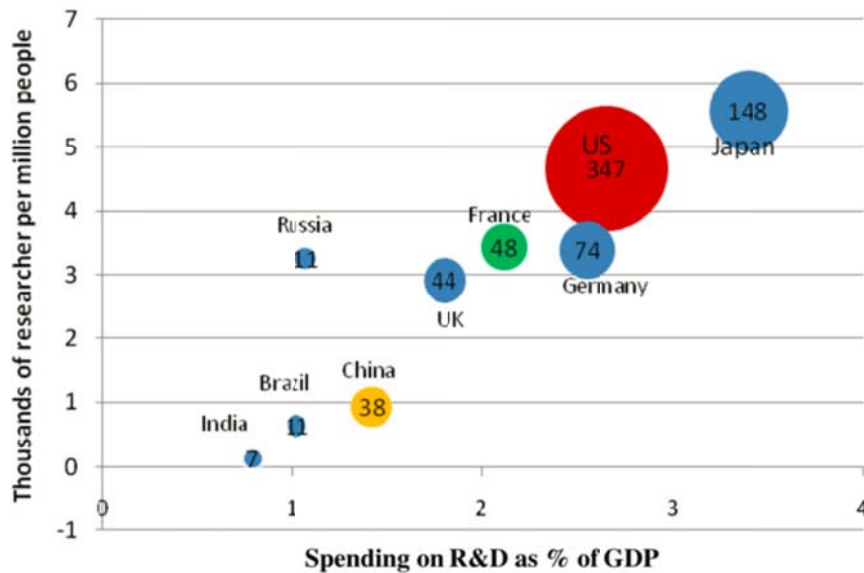


Figure 11: India’s position in the world in research and development terms<sup>1036</sup>

<sup>1036</sup> X. Fu, C. Pietrobelli, and L. Soete, ‘The Role of Foreign Technology and Indigenous Innovation in the Emerging Economies: Technological Change and Catching-up’, *World Development* (39) (2011), p. 1210.

#### **IV. The Importance of the Medical Technology Complex**

It is important to remember that the MTC is very different from a traditional industry. What defines a complex, and hence what differentiates it from an 'industry', is the number of stakeholders involved. Traditionally, an industry will have fewer stakeholders with a more focused and limited agenda. Automobiles, telecommunications, and finance are all large industries with big corporations, governmental structures, and well-organized associations.

There are a series of terms that should be identified, defined, and differentiated in order to better understand the MTC. The first is the medical industry complex, a term that has attracted considerable scholarly attention.<sup>1037</sup> However, previous definitions included only for-profit actors, predominately in the U.S. healthcare 'system'. A healthcare complex is defined as an aggregated group of uncoordinated and disintegrated actors providing healthcare to a population. This can be more aptly applied to the healthcare that is provided in the United States. National healthcare systems around the world predominately deliver services systematically in a coordinated and integrated fashion. The United States, with its multivariate healthcare models of nationalized, private, and programmes that mirror Beverage, creates a complex system of actors that have many levels of coordination, but act in a largely separate and unsystematic manner.

The last term is the global healthcare system and complex. Healthcare delivered globally acts, at times, in a systematic fashion. This is illustrated by clear singular leadership with a chain of command, a coordinated plan of action that requires several actors to organize their research and actions, and a clear and distinct goal. The MTC is an aspect of each of these groups, in that it is defined as the aggregate of groups that aim to develop, manufacture, distribute, and administer

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<sup>1037</sup> A.S. Relman, 'The New Medical-Industrial Complex', *New England Journal of Medicine*, 303 (17) (1980), pp. 963-70.

medical technologies. Previously, if a health system had no medical technology whatsoever, such as perhaps occurs in a low resource area, there would be no MTC presence.

Thus, the MTC consists of some organizations whose only purpose resides in developing, producing, distributing, and administering medical technology. But it also is part of many organizations that are not entirely dedicated to outcomes that involve medical technology. Life science companies, medical device companies, medical supply companies, medical informatics companies and associations, laboratories, radiology centres, and pharmacies are all dedicated to medical technology. However, there are many organizations, such as the Rockefeller Foundation, Gates Foundation, and World Bank that are focused on the development, production, distribution, and administration of medical technologies without being exclusively focused on that mission. For example, the American Red Cross has a mission to help people around the world; often, this mission is accomplished without the aid of medical technology. At other times, however, medical technology is at the core of its mission. The MTC is more effective when the departments or units within these organizations are actively engaged in a singular mission, particularly when they are coordinated and systematic in their efforts. The focus of the mission may differ, but the stakeholders converge in achieving a particular outcome.

Lastly, the MTC has a basis in improving human existence. Medical technology affects the monitoring, diagnosis, treatment, and on-going management of disease in human being, and plays a large part in the human condition around the world. Evidence of this can be seen in the fact that the United Nations Charter listed healthcare as a universal human right. It is these factors that make the MTC different from other large areas of economic activity around the globe.

The MTC in action was seen in the example of the eradication of smallpox discussed in Chapter 7. The WHO, as well as many foundations, worked in a cooperative fashion to ensure that medical technology was properly developed, produced, distributed, and administered. This effort showed the global healthcare system operating in unison to distribute and administer medical technologies. In that situation, the MTC became a coordinated and integrated set of actors working as a system in an organized fashion. But the MTC also exists where you have several different categories of agencies working towards a goal in an unsystematic or non-integrated fashion. For example, vaccination and family planning campaigns can be separately administered by various entities in a given country, including not-for-profits, missionaries, hospitals, healthcare insurance companies, and foundations. This is frequently seen in high resource nations such as the UK and the US, where there are many institutions that are trying to improve and save lives. It is rare to see this level of intervention occurring in low resource countries. In many of the larger countries around the world, such as India, Nigeria, Brazil, and Ghana, the global MTC becomes active to bring solutions to large populations in need of medical interventions, particularly if those nations have stable governments that will permit healthcare workers to operate without threat of violence or harm.

A more international case study of how the global health complex utilized the MTC in a disorganized and non-integrated fashion can be found in the response to the 2009 Haitian earthquake, which generated an immediate and substantial reaction. Aid from governments, universities, not-for-profits, missionaries, multilateral agencies, and corporations came in from all over the world. The city of Port-au-Prince was flooded with assistance ranging from portable cell phone towers for medical triage to medical supplies for patients in need of urgent care. In this case, there was no specific command and control for which resources and technologies were

distributed to different actors within the Haitian city. Thus, an uncoordinated complex formed amongst many different groups all attempting to provide aid to a desperate and hurting population. The Haitian example is another way of looking at how the MTC and a global health complex can interact.

The global importance of the MTC can be seen on a daily basis. Whether looking at preventative medicine, diagnostic services, treatment, on-going management, or emergency response, the health care spectrum requires the MTC at its most critical points of intervention. On the production side, we see the use of the MTC all the time. We see the MTC making strides to improve inventions that will help prevent major diseases for both low and high resource countries. In low resource countries, the various stakeholders of the MTC have implemented numerous interactive voice response programmes to remind expectant mothers to take their prenatal vitamins. These programmes continue to advise mothers to keep their zero to five year old children vaccinated, nourished, mosquito protected, and provided with potable water. For years, MTC stakeholders have pursued efforts for improving preventative care in lower resource countries through the use of various mobile phone and landline techniques, as well as e-mail and text reminders. In addition, breast and prostate exams and complete blood count tests are being provided on a regular basis for people to monitor their overall health. On the diagnostic side, the MTC has consistently put forward innovative diagnostic technologies to better serve patients for both safety and efficacy. Diagnostic equipment such as X-rays can now help doctors see into bodies by exposing patients to much lower levels of radiation than previous generations of X-rays.

An important and relevant element of the degradation of public health is the overregulation of the MTC. Some countries do not permit external agencies to pilot or provide

medical technology without federally centralized permission, which includes paying substantial fees, in addition to traditional ethics review board fees. These countries, including Uganda and Ethiopia, argue that such fees are necessary to ensure public safety. However, the result has been to dissuade the MTC from becoming more involved in the development of their health care services and products. These national examples of hyper-regulation illustrate just how important it is to understand the MTC and its modus operandi. Whilst regulation is important, and even critical, for many components within the MTC, hyper-regulation can result in an overall degradation of population health outcomes.

The MTC is most vital in times of urgent need. Global health structures such as the WHO and the CDC have become better acquainted with how to activate, implement, and manage the MTC over the years. The primary struggles remain in finding alignment within the MTC, so that all of the actors around the world are moving in a coordinated and systematic fashion to better utilize resources. The MTC moves within significant regulatory and free market factors, and can be better deployed when governments cooperate and proper pathways are in place.

One of the key conclusions of this work is uniqueness of the medical technology complex in India, and hence its likely irreproducibility. Nearly a dozen different factors came together for India to become a dominant market player in pharmaceuticals and ancillary technologies such as information technology and medical devices. None of these can be simply reproduced. For example, India's endowment with natural resources depends on natural factors beyond human control. Its geopolitical position in the Cold War, and resulting ability to attract Western investment, cannot be replicated. Its domestic demand for medical technology required a large domestic market and the ability to stimulate demand through manipulation of prices and

intellectual property rights, neither of which is easily replicated. In general, it was a unique constellation of actors in favourable circumstances that accounts for India's success.

The principal lesson of the Indian experience is, then, the open and active engagement with external entities. The Cold War situation will not be replicated; nonetheless, the concept of external engagement might successfully be generalized. Such engagement has both domestic and international aspects. During the period in question, India successfully engaged with Western and Soviet scientific and industrial entities, NGOs, foundations, religious organizations, and international and multilateral agencies. One principal network with which India engaged was the academic and research scientific community of the Commonwealth of Nations. Such engagement originated far before independence, and possessing an open economy and political system, India successfully maintained a central role in that network after independence. The external component of this – the existence of such a network within the Commonwealth – cannot be emphasized more strongly, but the domestic politics and economics of the country were equally essential. Indeed, India's ability to pivot its policies through economic liberalization in the 1980s and 1990s was key to its ability to maintain its role in this network, and draw on it to promote further growth. In the abstract, there is nothing to prevent other countries from replicating this engagement with the global academic and research community; indeed, one can see growing collaboration in places like Malaysia and the Persian Gulf.

The experience of the Indian pharmaceutical industry holds several lessons for other, less successful industrial sectors in India. First, if other industries positioned themselves as benefitting the national interest and social welfare of the country, they would attract greater attention, not only from the Indian government but from any potential supporters of maintaining

India as a viable and stable independent democracy. Such support would include international aid, FDI, grants, and indeed new business partners.

The educational sector could learn much from the experience of the pharmaceutical industry. Education is one of the few sectors in India that has yet to be completely liberalized, and many restrictions on foreign ownership still remain. If the sector were liberalized, its many stakeholders would be able to emulate many of the practices of the pharmaceutical industry. Education, much like healthcare, is seen by the international economic development community as a source of stability in free market democracy. India already has a vast network of professionals around the world in some of the highest positions in higher learning, and thus access to external resources. In other words, it has the ability to meet the extraordinary demand for education, driven by post-independence cultural shifts, that now exists in India. Efforts in education would attract significant amounts of international aid, foreign direct investment, and simply the goodwill of the international community in general and the Indian expatriate community in particular, and would certainly help India break the cycle of poverty that exists in many areas.

There are several lessons for other industries. The first is the need to keep labour costs low. In both the pharmaceutical industry and other internationally successful Indian industries such as software, India's advantages have come from its low labour costs. This is especially the case in lower-value-added sectors such as customer service centres. Though low labour costs are an essential factor, reliable telecommunications infrastructure and high competence in the English language are also required. Value will be added as education in technical areas is expanded, and there is much scope for India to move into a dominant position in computer science and software engineering.

Telecommunications is another sector in which India has been successful internationally. For example, most of Africa's mobile networks are owned by Indian nationals and companies, owning close to a 70% share of the market. Other major sectors such as electronics, textiles, and automobiles have greater barriers as the English language plays less of a role, and thus China and other manufacturing centres represent greater competition. The lesson is that the industrial sectors of the Indian economy that were the most highly automated were the ones to grow the fastest. The goal then is to pursue automation in other sectors.

#### **V. The Future of the Medical Technology Complex in India**

India has moved into an international leadership role in the manufacturing and distribution of medical technologies around the world. The country's vast and free labour market, the presence of strong socialist and communist parties, and its international policy of nonalignment have all allowed its own MTC to grow significantly over the past thirty years. India's status as the world's largest supplier of cheap medicines has provided it with unprecedented access to political leaders around the world. The implications of this are far-reaching and will require further research.

Understanding the development of the MTC in India provides tremendous insight into both the history of public health and the future of the diffusion of science around the world. Using the MTC in a systematic and structured fashion would appear to make many global public health transformations possible, as was the case with the smallpox eradication movement in the 1960s and '70s. The systematic and structured attack on smallpox around the world resulted in success for the MTC. A more recent example of the MTC in action is the HIV/AIDS movement in the late-1980s and early- to mid-1990s. In a piece published in June 2013, Allen Brandt

effectively demonstrated how the AIDS epidemic invented global health.<sup>1038</sup> The article has a timeline with key points in the history of HIV and AIDS.<sup>1039</sup> The timeline expressly demonstrates that the response to the spread of HIV/AIDS can, in large part, be said to have involved an MTC. The MTC was first involved during the diagnostic phase of HIV/AIDS treatment during the early 1980s. Then, during the clinical trials phase, the MTC was busy developing the first doses of zidovudine (AZT). Organizations formed to help battle the spread of AIDS, as well as discrimination against its patients, including the founding of the gay men's health crisis in 1982, the international council of AIDS service organizations in 1991, and the AIDS clinical trial group in 1994. These groups were fundamental to the development, production, distribution, and administration of the first medicines to manage the disease.

The Act Up campaign witnessed in many Western nations redirected hundreds of millions of dollars of funding toward preventative and treatment protocols for people in the HIV/AIDS community, including both those already infected with the virus, as well as those at risk of HIV/AIDS. The Clinton Foundation has also drawn on the leadership skills, knowledge, and charisma of former President Bill Clinton to bring together stakeholders from the public sector, private sector, and multilateral agencies to persuade global pharmaceutical companies to produce and distribute medications for HIV and AIDS at reduced cost, or even a loss. Clinton was thus able to forge alliances that helped administer life-saving medications in parts of the world that would previously have had little access to such treatments.

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<sup>1038</sup> A.M. Brandt, 'How AIDS Invented Global Health', *New England Journal of Medicine*, 368 (23) (2013), pp. 2149–52

<sup>1039</sup> *ibid*, p. 2150.

India has had a strong relationship with the Clinton Foundation since 2000, which began when the president visited India in 2000 during his first term.<sup>1040</sup> He was the first sitting U.S. President to visit India in more than 20 years. His visit was the foundation that eventually led to a partnership between India and the Clinton Foundation focused on the production, global distribution, and administration of life-saving medications to tens of millions of people who would otherwise be unable to afford these treatments. The Bill and Melinda Gates Foundation is another organization that works to improve global health by funding the development, production, distribution and administration of medical technologies. The Gates Foundation has been able to effectively broaden its impact and save tens of millions of lives through the use of cost-effective and high quality level drug manufacturers in India, as well as medical devices, medical suppliers, and medical informatics. The use of India as a hub for medical technology production has been a common thread across many of the world's most important and effective public health programmes since 1991. Numerous organizations have relied upon India's low cost, high quality production infrastructure, resulting in the medical technology sector growing faster than nearly every other sector in India (the notable exception being information technology).

Furthermore, India continues to add value to medical technology and healthcare internationally. The growth of healthcare costs over the past two decades has led stakeholders to scrutinize expenses. The pressure to decrease costs has prompted organizations to find new ways to produce goods and services for less. India's immense, highly trained workforce, the free labour market, as well as its free market economic structure, have provided the perfect ecosystem for these organizations to find new ways to dramatically reduce operating overheads. For example,

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<sup>1040</sup> C.W. Dugger, 'Clinton Fever: A Delighted India Has All the Symptoms', *New York Times*. Accessed at [www.nytimes.com/2000/03/23/world/clinton-fever-a-delighted-india-has-all-the-symptoms.html?module=Search&mabReward=relbias%3Ar%2C%221%22%3A%22RI%3A6%22](http://www.nytimes.com/2000/03/23/world/clinton-fever-a-delighted-india-has-all-the-symptoms.html?module=Search&mabReward=relbias%3Ar%2C%221%22%3A%22RI%3A6%22).

the need for medical information system in Europe, the United Kingdom and North America has so dominated modern hospital operations that today the producers of these systems, including GE, Cerner, and Allscripts have created vast subsidiaries in the India to support the growth of customer base around the world. In addition, Indian subsidiaries of companies like Oracle, Quintiles, and Metadata produce and maintain electronic data capture systems which allow clinical trials researchers to enter patient data directly into computers, eliminating the need for paper. Finally, companies such as Aetna, Cigna, United Healthcare, and Humana have extensive operations in India that support internal software and business processes of checking cleans and following up on provider and queries.

However, the growth of India's MTC has been far more than the medical device and life sciences departments. Over the past twenty years the growth of a field called biomedical informatics, that is the capture, storage, storage, retrieval, visualization, and analysis of biomedical data, including medical records and healthcare claims, has exploded in developed countries around the world. From New Zealand to the European Union to the United Kingdom to the United States, nations and hospital systems have adopted electronic health records at a feverish pace, requiring them to find sources of intellectual capital to produce and maintain these systems. India's computer science competency, graduating roughly 40,000 computer scientists per year (versus the U.S., which graduates 4,000), has been highly attractive to biomedical informatics companies, governmental agencies, and not-for-profits. The need to reduce healthcare costs whilst implementing and maintaining these systems at the lowest possible cost has led many countries to embrace India's medical technology community. The growth in these sectors has been substantial and shows no sign of subsiding. With increasing healthcare costs and shrinking national healthcare budgets, the growth of the Indian MTC over the next 10 years will

mostly like continue at its current pace, and could even eclipse past levels. Indeed, as Richard S. Bazaar, M.D., the former Chief Medical Officer at IBM Americas Healthcare Solution Sales in North America, noted, due to the growth of the healthcare information service sector around the world, India now was the home of more than 50% of IBM's global workforce of 426,751.<sup>1041</sup>

However, historians such as Mathew Connelly and Marika Vicziany hold that the MTC is inconsistent with good ethical practice in science and medicine. Connelly, for example, has shown that the family planning programmes of the 1960s and '70s forced contraception on to populations; instead of providing local populations with a choice between options, the programmes presented the data in a fashion that suggested contraception was the only plausible choice. Birth control and fertility were marketed as a public health obligation for both men and women, rather than a choice. The enthusiasm and zealotry of these campaigns took on the air of a smallpox eradication or polio vaccination campaign, and did not present the decision as one surrounded with moral and personal considerations.

One of the overarching crises in India over the last twenty years has been the destruction and depletion of its environmental resources. Whether looking at natural resources such as water or mineral resources such as magnesium, the core components of India's environmental status have all been significantly affected over the course of its development. The MTC is part of this systematic erosion. As we saw in the earliest chapters of this work, one of the key elements of the development of India's medical technology was its natural resources. Since 1991, India has continued to harvest its natural resources at extraordinary rates. Whilst this was a key component in India's success in the mid- and late-twentieth century, certain natural resources like fresh

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<sup>1041</sup> Interview Dr. Richard Bakalar 22 January 2010, IBM Global Workforce in 2010. Accessed at [www.ibm.com/annualreport/2010/financial-highlights.html](http://www.ibm.com/annualreport/2010/financial-highlights.html).

water have been over utilized, causing shortages in some areas. Much of the country's continued growth will require significant conservation efforts in these areas.

Despite the positive aspects the MTC has brought to India, some argue that prevents companies from seeking cures for diseases because of the profitability of selling treatments. This line of thinking was explored for the 'military industrial complex' in a 1965 article in the *Journal of Social Issues*. The authors, Drs. Pilisuk and Hayden, discussed whether the military industrial complex in fact prevents peace.<sup>1042</sup> History has shown that smallpox has been eradicated due to the development of the MTC. However, the technological focus on healthcare by entities like the Gates Foundation and WHO diverts resources away from other areas of need, such as primary healthcare, which requires hands-on diagnostics and long-term environmental improvements in public health, sanitation, etc. This is further illustrated by looking at the WHO's current list of the three primary global health initiatives. These include rolling back malaria, stopping the spread of tuberculosis, and creating a global alliance for vaccines and immunizations, all of which have medical technology as the foundation of their mission. It might even be said that much of the global health system is merely a distribution channel for the MTC to expand its production, profits, and influence.

As one wave of diseases passes, another unfortunately emerges. The most recent global health crisis – the spread of the Ebola virus from an outbreak in West Africa to other parts of the world, including the EU and North America – is only the latest test of the MTC. The non-profit group Doctors Without Borders responded immediately to the outbreak in March 2014 at ground zero in Liberia, Guinea-Bissau, and other West African countries. Doctors Without Borders were calling for international action within 30 days, arguing that the outbreak was out of control. But

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<sup>1042</sup> M. Pilisuk and T. Hayden, 'Is there a Military Industrial Complex Which Prevents Peace?: Consensus and Countervailing Power in Pluralistic Systems', *Journal of Social Issues* 21 (3) (1965), pp. 67–117.

the MTC, including countries such as the U.S. and the United Kingdom, as well as multilateral agencies like the WHO, were slow to respond. The outbreak has now taken the lives of thousands of West Africans and spread to many other parts of the world. Had the global health system and MTC been more responsive, their support could have been instrumental in providing infrastructure and medicine support to stem the epidemic in those countries. It remains to be seen if the MTC, including life science companies, can bring about new vaccines that have been stored in spare rooms for exactly such an outbreak. And if the CDC in the United States can share more information with the MTC about testing on new vaccinations and new treatments for Ebola that has yet to be shared. The effectiveness of the global response to the crisis in West Africa and the rest of the world could determine the fate of thousands, if not tens of thousands, of people over 2015 and beyond.

## **VI. Conclusion: A Medical Technology Power is Born**

Reviewing historical models that discuss the spread of Western medicine and the diffusion of medical technologies from one country or stakeholder – or, as George Basalla put it, one host – to another, it is clear that the structure of the MTC is very loose and hybrid. It is important to understand that the diffusion and spread of technology is not a one-way path. One of the key aspects of this work discussed in the early chapters was the diffusion of Western science and technology. It was clear that the work of Basalla, first published in 1967, had enormous application to the diffusion of technology in India. Not only did his model illustrate the diffusion of technology from phase one through phase three, it also provided the background to understand that once the relevant actors had mastered these phases, they would emerge as leaders of world science. Clearly, his model applied to India from 1947 to 1991, in that India moved from

recipient to world leader in line with Basalla's model. The MTC also aligns nicely with Chakrabarti's model of shared data from rural to urban and urban to rural, which was illustrated in Chapters 5 and 6. The advent of medical technology growth in India involved the entire country in developing medical technology, whether it meant manufacturing in urban cities or clinical trials in rural villages. Everett Roger's work on the diffusion of innovation as a process by which messages are communicated through channels of a social system, eventually leading to the large scale adoption of new technologies, can also be seen in the Indian diaspora. These theorists and their models played a significant role in the investigation into the history of the development of medical technology in India and the identification of the MTC.

India's dominance in medical technology has led to it assuming a position of leadership internationally. Through the use of various forms of Western medicine, India has become a leader in medical tourism, medicines, medical devices, and medical supplies. The spread of Western medicine and a fusion of medical technologies by India improved its geopolitical situations around the world. By the turn of the century, India had become a major actor in the global medical community. On March 5, 2005, there was a six-paragraph editorial in the *New York Times* entitled, 'AIDS Drugs Threatened' that summarized a bill in the Indian Parliament that would affect India's ability to remain a low-cost generic AIDS medication supplier.<sup>1043</sup> The article argued, 'If Parliament can preserve India's ability to provide generic versions of these medicines, it will make the difference between life and death for millions of people at home and abroad.'<sup>1044</sup> The *New York Times*' opinion illustrates just how critical India's position in the global medical technology environment has become. Medical technology in India is today one of the largest by volume in the world. In an age of information revolutions, India's role should not

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<sup>1043</sup> 'AIDS Drugs Threatened', *New York Times*, 5 March 2005, p. A12.

<sup>1044</sup> *ibid.*

be ignored, as its influence internationally in the global healthcare system will need to be better understood. India's medical technology will be constantly evolving, just as science, medicine and their applications to society are ever evolving.

In conclusion, this thesis has showed how the MTC in India, a country barely surviving in 1947, became one of the world's foremost providers of medical technology. In 1947, the MTC in India barely existed. It consisted predominately of the resources that were provided by the British Empire as a means to maintain order for the proper execution of a colonial government: primarily for harvesting key economic goods. It also consisted of some medical missionaries whose primary purpose was to save souls and recruit members for their congregation. By 1991, the MTC had a vast number of institutions involved in assisting India's healthcare system. It was also supplying many countries, foundations, and corporations the critical medical technologies needed in order to meet their various agendas around the world. This would only be the beginning, as medical technology in India from 1991 forward would continue to grow in both economic activity as well as human impact, in large part because of the MTC.

## BIBLIOGRAPHY

### Archives

#### **Eisenhower Presidential Library:**

Hagerty, J.C., Press Release Containing the Text of the Address by President Eisenhower, Broadcast and Televised from his office in the White House, Eisenhower's Papers as President, Speech Series, Eisenhower Presidential Library, Abilene, KS, 17 January 1961, Box 38, Final TV Talk, 1.

Kennedy, T.R., Letter from Professor Theodore R. Kennedy to Dwight D. Eisenhower, D.D.E.'s Post-Presidential Papers, Abilene: Eisenhower Presidential Library, 13 June 1967. (1966 Principal File, Box 5, Business Economics, 6).

Larson, A. and Moos, M., Outline of Subjects for Presidential Talks to be made by Dwight D. Eisenhower, Arthur Larson and Malcolm Moos Records, Abilene: Eisenhower Presidential Library, 22 May 1959. (Box 17, Presidential Speech Planning).

Letter to T. R. Kennedy, Reply from Dwight D. Eisenhower to Professor Theodore R. Kennedy, D.D.E.'s Post-Presidential Papers, Abilene: Eisenhower Presidential Library, 21 June 1967. (1966 Principal File, Box 5, Business Economics, 6).

#### **Miscellaneous:**

AIIMS Archives. Accessed at [www.aiims.edu/aiims/ritact/AIIMS-ACT-RULES.pdf](http://www.aiims.edu/aiims/ritact/AIIMS-ACT-RULES.pdf).

*Annual Report 1965*, International Monetary Fund. Accessed 18 July 2014 at [www.imf.org/external/pubs/ft/ar/archive/pdf/ar1965.pdf](http://www.imf.org/external/pubs/ft/ar/archive/pdf/ar1965.pdf).

*Annual Report 2011-12*, Government of India, New Delhi: Department of Pharmaceuticals, 2012. Accessed at <http://pharmaceuticals.gov.in>.

Archives of the International Monetary Fund, Washington, DC, EBS/81/198, p. 3.

‘Competitiveness of the Indian Pharmaceutical Industry in the New Product Patent Regime’,  
Federation of Indian Chambers of Commerce and Industry (New Delhi, March 2005).

‘Conclusions of a Meeting of the Cabinet held at 10 Downing Street, S.W.1, on Thursday, 21  
October 1971, at 11 a.m.’, (Jan. 1973), National Archives of the United Kingdom.

Department of Industrial Development, Ministry of Industry: Exhibit No. 1, Industrial Policy  
Resolution, 30 April 1956.

Eisenhower Appointment Schedule, 1 December 1959 to 31 December 1959, Presidential  
Papers: Dwight D. Eisenhower Diary Series. Accessed 5 September 2013 at  
[http://web2.millercenter.org/dde/documents/presidential\\_papers/dde\\_diary\\_series/1959/de\\_1959\\_12.pdf](http://web2.millercenter.org/dde/documents/presidential_papers/dde_diary_series/1959/de_1959_12.pdf).

Farewell call of the Indian Ambassador, Sir Benegal Rama Rau, U.S. Department of States  
Memorandum of Conversation, Harry S. Truman Library & Museum Acheson  
Memoranda of Conversation, Independence, MO, 1949.

Gouri, B., ‘Competition Issues in the Generic Pharmaceuticals Industry in India’, Speech outline  
given at the Competition of Commission India (New Delhi, 14 August 2010).

Government of India, Ministry of Health and Family Welfare, National Health Policy 2002 (New  
Delhi, 1996).

International Monetary Fund, GATT – Balance of Payments Consultations – Acceptance of  
Invitation, Representation and Guidance for July Meeting (1967). Accessed at  
[www.imf.org](http://www.imf.org).

*Pharmaceuticals: A Sector Study Summary*, Indian Institute of Food Technologists (1991),  
Unpublished Report. Accessed at Lady Harding Medical School Archives.

Proceedings from Grand Jury Testimony of Richard M. Nixon, Hoover Reporting Co., Inc., San Clemente: Nixon Presidential Library, 24 June 1975.

*Report of the Committee on Drugs and Pharmaceutical Industry* (Hathi Committee Report), Government of India (1975). Accessed 15 September 2013 at [www.communityhealth.in/~commun26/wiki/index.php?title=File:Hathi\\_Committee\\_report\\_1975.PDF.pdf](http://www.communityhealth.in/~commun26/wiki/index.php?title=File:Hathi_Committee_report_1975.PDF.pdf).

*Report of the Health Survey and Development Committee, Vol. I* (New Delhi, 1946). Accessed 16 July 2014 at [www.nhp.gov.in/bhore-committee](http://www.nhp.gov.in/bhore-committee).

*Report of the Health Survey and Development Committee, Vol. II* (New Delhi, 1946). Accessed 16 July 2014 at [www.nhp.gov.in/bhore-committee](http://www.nhp.gov.in/bhore-committee).

Umar Ruhi, University of Ottawa, Canada. Sitwat Langrial, University of Oulu, Finland.

#### **National Archives of India (NAI):**

‘Activities of the Health Organization of the League of Nations During the War’, Geneva:

League of Nations, 1945, NAI.

Comments on the Paper on Drugs and Pharmaceuticals, Prime Minister’s Office, File No. 17-1315-1972 PMS, NAI.

Covington & Burling Letter to Prime Minister, File No. 17-1315-1977 PMS, NAI.

External Affairs Min – 1953 – File No. – Progs. Nos. 3041(71)-AMS, (1953), NAI.

Government of India, (1970), NAI.

Letter from Jivraj Mehta, Secretary of the Health Ministry and Director General of Health

Service to G. S. Rau, Government of India Economy Committee, 31/5/48, (Box 136),

NAI.

Letter from Shri P.S. Ramachandran to Prime Minister Desai, File No. 17-1315-1977 PMS, NAI.

Letter to the Committee on the Economy, March 1950, (Box 158), NAI.

Letter to the Health Minister, March 1948, (Box 136), NAI.

Letter to the Secretary to the Government of India, Ministry of Health, from the Director General of Health Services, 11/03/1948, NAI.

Menon, V., Office of External Affairs, Government of India, 1947, NAI.

Report on the Public Health Programs of India, Government of India Health Ministry (1932), NAI.

Second Annual Health Minister's Report, August 1948, (Box 192), NAI.

**Oxford: Bodleian Library of Commonwealth and African Studies at the Rhodes House:**

Barton, D.M., Letter to Dr. Thres., Oxford: Bodleian Library of Commonwealth and African Studies at the Rhodes House, 27 January 1964. (Special Collections & Western MSS, M354).

De la Hoyde, D., Letter to Dr. Thres, Oxford: Bodleian Library of Commonwealth and African Studies at the Rhodes House, 9 November 1966 (Special Collection & Western MSS).

Drage, L.H., Letter to D. Wright, Oxford: Bodleian Library of Commonwealth and African Studies at the Rhodes House, 13 October 1967 (Special Collection & Western MSS, M467).

Jensen, L.L., Letter to Dr. K. Wright, Oxford: Bodleian Library of Commonwealth and African Studies at the Rhodes House, 17 May 1971. (Special Collection & Western MSS).

Letter from Dr. Mary Gell, SPG, Oxford: Bodleian Library, 25 July 1949, (USPG Papers, M502).

Letter from Dr. Mary Gell, SPG, Oxford: Bodleian Library, 31 March 1949, (USPG Papers, M502).

Letter from Grindlays Bank Limited, Oxford: Bodleian Library, 21 March 1949, (USPG Papers, M502).

Letter from J.N. Saksena, Under Secretary, Minister of Health, Oxford: Bodleian Library, 27 October 1949, (USPG Papers, M502).

Letter from Office of the High Commissioner for India, Commerce Department, India Supply Commission, London, Oxford: Bodleian Library, 21 March 1949, (USPG Papers, M502).

Letter from Right Reverend F.J. Western, Oxford: Bodleian Library, 19 March 1948, (USPG Papers, D523/5).

Siemens-Reiniger-Werke Corporation representative, Letter to The Society for the Propagation of the Gospel in Foreign Parts, Oxford: Bodleian Library of Commonwealth and African Studies at the Rhodes House, 6 March 1964. (Special Collections & Western MSS, M337).

Taylor, F., Letter to the United Society for the Propagation of the Gospel, Oxford: Bodleian Library of Commonwealth and African Studies at the Rhodes House, 27 November 1971. (Special Collection & Western MSS).

Taylor, P.F., Report of St. Luke's Village Health Project, Oxford: Bodleian Library of Commonwealth and African Studies at the Rhodes House, 30 April 1972. (Special Collection & Western MSS).

**Rockefeller Archives:**

16 April 1962, Rockefeller Family Archives, Record Group 1.2, Series 464, Box 40, Folder 335.

Alan Gregg diary entry, 28 January 1952, Rockefeller Family Archives, Record Group 1.2, Series 464, Box 40, Folder 305.

Anderson, R.K., M.D., Letter to Dr. Lucien Gregg, Rockefeller Archive Center, Butler Library, Columbia University, 23 March 1962, Folder 335, Box 40.

Letter from Dr. Watson to Gregg, 17 April 1952, Rockefeller Family Archives, Record Group 1.2, Series 464, Box 40, Folder 305.

Director for Medical and Natural Sciences Report for the All India Institute of Medical Sciences, 1 December 1943, Rockefeller Foundation Archives, Box 37, Folder 305.

Gregg, L.A., M.D., Letter to Dr. B. B. Dikshit, Rockefeller Archive Center, Butler Library, Columbia University, 5 March 1962, Folder 335, Box 40.

Letters and receipts, Rockefeller Family Archives, Record Group 1.2, Series 464, Box 40, Folder 335.

Letters to and from Delhi and New York, Rockefeller Family Archives, Record Group 1.2, Series 464, Box 40, Folder 305.

### **Published Primary Sources**

Cerra, V. and Saxena, S.C., 'What caused the 1991 currency crisis in India?', *IMF Staff Papers*, 49(3) (2002), pp. 395–425.

Das Gupta, M., 'Public Health in India: An Overview', *World Bank Policy Research Working Paper*, (3787) (2005). Accessed at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=873895](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=873895).

'Global Strategy for Infant and Young Child Feeding', World Health Organization and UNICEF (2003). Accessed at <http://apps.who.int/iris/handle/10665/42590>.

Greene, W., *The Emergence of India's Pharmaceutical Industry and Implications for the US Generic Drug Market* (Publication No. 2007-05-A) (Washington, D.C.: Office of Economics and U.S. International Trade Commission, 2007). Accessed 15 September 2013 at [http://www.usitc.gov/publications/332/working\\_papers/EC200705A.pdf](http://www.usitc.gov/publications/332/working_papers/EC200705A.pdf).

Henderson, D.A., 'Principles and lessons from the smallpox eradication programme', *Bulletin of the World Health Organization*, 65(4) (1987), pp. 535–46.

'India 1991 Country Economic Memorandum', *World Bank*, (Report No. 9412-IN, Vol. I) (23 August 1991).

'India Achievements and Challenges in Reducing Poverty', *World Bank*, (Report No.16483-IN) (27 May 1997). Accessed 15 September 2013 at [www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1997/05/27/000009265\\_3971104184304/Rendered/PDF/multi\\_page.pdf](http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1997/05/27/000009265_3971104184304/Rendered/PDF/multi_page.pdf).

India's Planning Commission, Fifth Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

India's Planning Commission, First Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

India's Planning Commission, Fourth Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

India's Planning Commission, Second Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

India's Planning Commission, Seventh Five-Year Plan, (Vol. I). Accessed 25 July 2014 at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

India's Planning Commission, Seventh Five-Year Plan, (Vol. II). Accessed 25 July 2014 at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

India's Planning Commission, Sixth Five-Year Plan. Accessed 25 July 2014 at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

India's Planning Commission, Third Five-Year Plan. Accessed at <http://planningcommission.nic.in/plans/planrel/fiveyr/welcome.html>.

Kohli, R., 'Capital Flows and Their Macroeconomic Effects in India', *International Monetary Fund Working Paper* (WP/01/192) (November 2001).

'Local Production and Technology Transfer to Increase Access to Medical Devices', (Geneva: World Health Organization, 2012).

'Medical devices: Context, Outcomes, and Future Actions', Version 8, 1<sup>st</sup> Forum (Geneva: World Health Organization, April 2011).

'National Council of Educational Research and Training, Review of Education in India: 1947–61', *Ministry of Education* (New Delhi, 1961).

National Health Mission, Ministry of Health & Family Welfare, Government of India, NRHM Framework for Implementation. Accessed 11 August 2014 at <http://nrhm.gov.in/nhm/nrhm/nrhm-framework-for-implementation.html>.

Paddock, R., 'Medical Device Regulatory Profile for India', New Delhi: Office of Health and Consumer Goods, International Trade Commission, 2010. Accessed 18 September 2013 at <http://cdsco.nic.in>.

The All India Institute of Medical Sciences Act, 1956. Accessed 15 September 2013 at [www.aiims.edu/aiims/ritact/AIIMS-ACT-RULES.pdf](http://www.aiims.edu/aiims/ritact/AIIMS-ACT-RULES.pdf).

The Patents Act, No. 38 of 1970, §§ 116(3), 117(1). Accessed at <http://indiacode.nic.in>.

‘UNICEF United Nations Children Fund’, *UNICEF Annual Report 1986* (1987). Accessed at [www.unicef.org/about/history/index\\_annualreports.html](http://www.unicef.org/about/history/index_annualreports.html).

‘Universal Declaration of Human Rights’, Resolution adopted by the General Assembly of the United Nations, (10.12) (1948).

*Working for Health: An Introduction to the World Health Organization* (World Health Organization, 2007).

World Health Organization (ed.), *World Health Statistics 2008* (2008).

World Health Organization. Accessed 14 July 2014 at [www.who.int/csr/disease/smallpox/en/](http://www.who.int/csr/disease/smallpox/en/) on.

World Health Organization, Bulletin, Smallpox: dispelling the myths. An interview with Donald Henderson. Accessed 24 July 2014 at [ww.who.int/bulletin/volumes/86/12/08-041208/en/](http://www.who.int/bulletin/volumes/86/12/08-041208/en/).

World Health Organization Media Centre, Anniversary of Smallpox Eradication Podcast Transcript. Accessed 14 July 2014 at [www.who.int/mediacentre/multimedia/podcasts/2010/smallpox\\_20100618/en/](http://www.who.int/mediacentre/multimedia/podcasts/2010/smallpox_20100618/en/).

### **Published Secondary Sources**

‘A Decade of Sanitex: Progress’, *The Times of India*, 30 June 1955, p. 12.

‘A Question of Costs’, *The Times of India*, 12 January 1966, p. 8.

‘A Salute to Jenner’, *The Times of India*, 5 July 1975, p. 6.

‘AIDS Drugs Threatened’, *The New York Times*, 5 March 2005, A12.

Accessed at [www.friendskorner.com/forum/f137/debate-illingworth-cartoons-india-daily-mail-uk-1942-1946-a-267120/](http://www.friendskorner.com/forum/f137/debate-illingworth-cartoons-india-daily-mail-uk-1942-1946-a-267120/).

‘Activities of foreign missionaries condemned’, *The Times of India*, 6 April 1954, p. 8.

‘Advantages of MRI’, *The Times of India*, 19 November 1990, p. 20.

- Ahmad, A., 'Regional Pattern of Industrial Licensing', *Social Scientist*, 2(9) (1974), pp. 3–17.
- Ahmad, H., *Technological Development in Drugs & Pharmaceutical Industry in India* (New Delhi, 1988).
- Akamatsu, K., 'A Historical Pattern of Economic Growth in Developing Countries', *The Developing Economies*, 1(s1) (1962), pp. 3–25.
- Altman, L.K., 'India Declared Free of Smallpox; Two Countries Left', *The New York Times*, 3 July 1975, p. 29.
- AMIA. Accessed at [www.amia.org/about-amia/science-informatics](http://www.amia.org/about-amia/science-informatics).
- Amrith, S.S., *Health and Well-Being in Colonial and Postcolonial India*. Accessed 15 September 2013 at [www.princeton.edu/chw/events\\_archive/repository/03272006\\_amrith/03-27-07.pdf](http://www.princeton.edu/chw/events_archive/repository/03272006_amrith/03-27-07.pdf).
- Amuzegar, J., 'Economic systems in search of nations', *Social Research*, 35(1) (1968), pp. 202–15.
- Anand, R.S., 'Reflections on Forty Years of Freedom', *India – West*, 14 August 1987.
- Anderson, M.R. and Guha, S., *Changing concepts of rights and justice in South Asia* (Oxford, 2000).
- Arnold, D. and DeWald, E., 'Cycles of Empowerment? The Bicycle and Everyday Technology in Colonial India and Vietnam', *Comparative Studies in Society and History* 53(4) (2011), pp. 971–996.
- Arnold, D., 'Global Goods and Local Usages: The Small World of the Indian Sewing Machine, 1875–1952', *Journal of Global History*, 6(3) (2011), pp. 407–429.
- Arnold, D., *Science, Technology and Medicine in Colonial India* (Vol. 3) (Cambridge, 2000).

- Arnold, D., 'Smallpox and Colonial Medicine in Nineteenth Century India', *Institutions and Ideologies: A SOAS South Asia Reader*, 24(10) (1993), pp. 224–44.
- Aron, L.R., 'The "Mystery" of the Soviet Collapse', *Journal of Democracy*, 17(2) (2006), pp. 21–35.
- Asadullah, M.N. and Yalonetzky, G., 'Inequality of Educational Opportunity in India: Changes Over Time and Across States', *World Development*, (40)6 (2012), pp. 1151–63.
- Aurobindo, About Us. Accessed 5 September 2014 at [www.aurobindo.com/about-us/overview](http://www.aurobindo.com/about-us/overview).
- B. Braun, German Chancellor Angela Merkel opens B. Braun production facility in Vietnam. Accessed 5 August 2014 at [http://eu.bbraunoem.com/cps/rde/xchg/oem-bbraunoem-en-eu/hs.xsl/news\\_8717.html](http://eu.bbraunoem.com/cps/rde/xchg/oem-bbraunoem-en-eu/hs.xsl/news_8717.html).
- Bagchi, A.K., Banerjee, P., and Bhattacharya, U.K., 'Indian Patents Act and Its Relation to Technological Development in India', *Economic and Political Weekly*, (1984), pp. 287–304.
- Bajpai, V. and Saraya, A., 'For a Realistic Assessment A Social, Political and Public Health Analysis of Bhore Committee', *Social Change*, 41(2) (2011), pp. 215–31.
- Banerjee, M., *Power, Knowledge, Medicine: Ayurvedic Pharmaceuticals at Home and in the World* (New Delhi, 2009).
- Banik, D., 'Growth and Hunger in India', *Journal of Democracy*, (22)3 (2011), pp. 90–104.
- Bansal, P. and Supe, A., 'Training of Medical Teachers in India: Need for Change', *Indian Journal of Medical Sciences*, 61(8) (2007), pp. 478–84.
- Bapat, N., 'How Indians Defied Gravity and Achieved Success in Silicon Valley', *Forbes*, 15 October 2012. Accessed 4 September 2014 at

- [www.forbes.com/sites/singularity/2012/10/15/how-indians-defied-gravity-and-achieved-success-in-silicon-valley/](http://www.forbes.com/sites/singularity/2012/10/15/how-indians-defied-gravity-and-achieved-success-in-silicon-valley/).
- Bart, B., 'Boom is Sparked by Exotic Plants', *The New York Times*, 28 February 1960, p. 1.
- Barts and the London Chronicle*, 8(1) (2006).
- Barton, C., *The Red Cross in Peace and War* (Washington D.C., 1910), p. 333.
- Basalla, G., 'The Spread of Western Science', *Science*, 156(3775) (1967), pp. 611–22.
- 'Bayer (India) Limited: Speech of the Chairman, Mr. B.M. Ghia', *The Times of India*, 9 April 1970, p. 9.
- Bella, N., *Impact of Demographic Trends on the Achievement of the Millennium Development Goal of Universal Primary Education*. Accessed at [www.un.org/esa/population/publications/PopAspectsMDG/06\\_UNESCO.pdf](http://www.un.org/esa/population/publications/PopAspectsMDG/06_UNESCO.pdf).
- Bhalla, G.S., 'Peasant Movement and Agrarian Change in India', *Social Scientist* 11(8) (1983), pp. 39–57.
- Bhandari, B., *The Ranbaxy Story* (New Delhi, 2005).
- Bhatt, M.C., 'Canada-India Investment of Promotion and Transfer of Technology with Special Reference to the Role of Joint Ventures in Retrospect and Prospect', *Journal of Developing Societies* (7).
- Bhattacharya, S., *Expunging Variola: The Control and Eradication of Smallpox in India*, (Hyderabad, 2006).
- Bhattacharya, S., Harrison, M. and Worboys, M., *Fractured States: Smallpox, Public Health and Vaccination Policy in British India 1800-1947* (Vol. 11) (New Delhi, 2005).
- Bianchi, P. and Labory, S., *International Handbook on Industrial Policy* (Northampton, 2008).
- Binder, D., 'Foreign Currency Aids US Science', *The New York Times*, 30 December 1973, A1.

Biocon. Accessed 5 September 2014 at [www.biocon.com/biocon\\_aboutus\\_history.asp](http://www.biocon.com/biocon_aboutus_history.asp).

Bode, M., *Taking Traditional Knowledge to the Market: The Modern Image of Ayurvedic and Unani Industry, 1980-2000* (Hyderabad, 2008).

Bonair, A., Rosenfield, P. and Tengvald, K., 'Medical Technologies in Developing Countries: Issues of Technology Development, Transfer, Diffusion and Use', *Social Science & Medicine* 28(8) (1989), pp. 769–81.

'Boots Co. (India) sales', *The Times of India*, 8 May 1981, p. 13.

Borders, W., 'Emergency in India Entering New Phase', *The New York Times*, 26 December 1975, p. 65.

Bordo, M.D., Taylor, A.M. and Williamson, J.G., (eds.), *Globalization in Historical Perspective* (Chicago and London, 2007).

Boughton, J.M., 'Silent Revolution: The International Monetary Fund, 1979–89', *International Monetary Fund* (2001).

Brand, N., 'Operations Strategy and Management within Oxfam' (2007). Accessed 26 March 2014 at [www.grin.com/en/e-book/69646/operations-strategy-and-management-within-oxfam](http://www.grin.com/en/e-book/69646/operations-strategy-and-management-within-oxfam).

Brandt, A. M., 'How AIDS Invented Global Health', *New England Journal of Medicine*, 368(23) (2013), pp. 2149-52.

'Building up of Social and Economic India Structure: Simultaneous Efforts Urged by Mehta', *The Times of India*, 23 November 1966, p. 9.

'Calcutta Medical College', *The Lancet*, 114(2928) (1879), p.558.

Callahan, D., 'Health Care Costs and Medical Technology', The Hastings Center. Accessed at [www.thehastingscenter.org/Publications/BriefingBook/Detail.aspx?id=2178](http://www.thehastingscenter.org/Publications/BriefingBook/Detail.aspx?id=2178).

- Carpenter, D., *Reputation and Power: Organizational Image and Pharmaceutical Regulation at the FDA*, (Princeton, 2014).
- Castells, M., Hall, P., and Jennings, L., *Technopoles of the World: The Making of 21<sup>st</sup> Century Industrial Complexes* (London, 2004).
- CDC, Centers for Disease Control and Prevention – Global Health. Accessed 9 September 2014 at [www.cdc.gov/globalhealth/programs/immunization.htm](http://www.cdc.gov/globalhealth/programs/immunization.htm).
- ‘Central Pool of Medicines: Minister’s Proposal’, *The Times of India*, 4 February 1952, p. 3.
- ‘Centres to Help Health Services’, *The Times of India*, 21 February 1948, p. 5.
- Chakrabarti, P., *Bacteriology in British India: Laboratory Medicine and the Tropics* (Rochester, 2012).
- Chakrabarti, P., ‘Beasts of Burden: Animals and Laboratory Research in Colonial India’, *History of Science*, 48(2) (2010), pp. 125–52.
- Chakrabarti, P., *Western Science in Modern India: Metropolitan Methods, Colonial Practices* (New Delhi, 2004).
- Chakrabarti, P., *Medicine and Empire, 1600-1960* (London, 2013).
- Chamarbagwala, R. and Sharma, G., ‘Industrial De-licensing, Trade Liberalization, and Skill Upgrading in India’, *Journal of Development Economics*, 96(2) (2011), pp. 314–36.
- Chandavarkar, R., ‘Industrialization in India before 1947: Conventional Approaches and Alternative Perspectives’, *Modern Asian Studies*, 19(3) (1985), pp. 623–68.
- Chandavarkar, R., *The Origins of Industrial Capitalism in India: Business Strategies and the Working Classes in Bombay, 1900–1940* (Vol. 51) (Cambridge, 2003).
- Chandra, B., Mukherjee, M. and Mukherjee, A., *India After Independence: 1947–2000* (New Delhi, 1999).

- Chandra, B., Mukherjee, M., and Mukherjee, A., *India Since Independence* (New York, 2008).
- Chase-Ortiz, M., *Pharma Sourcing from India and China* (Presentation in Berlin, 2009).
- Chatterji, N., 'Giant Strides Made by Our Pharmaceutical Industry', *The Times of India*, 12 February 1973, p. 19.
- Chaurasia, A.R. and Gulati, S.C., *India: The State of Population 2007* (Oxford, 2008).
- Chowdary, N. (ed.), *Healthcare Sector* (Hyderabad, 2003).
- Chowdhury, K., *The New India: Citizenship, subjectivity, and economic liberalization* (New York, 2011).
- Check, E., 'The Treasure of Mumbai', *Wired Magazine*, (December 2006). Accessed 18 September 2014 at <http://archive.wired.com/wired/archive/14.12/indiadrug.html>.
- Chen, K. and Zhang, X., 'Trial by Media: Overcorrection of the Inadequacy of the Right to Free Speech in Contemporary China', *Critical Arts: South-North Cultural and Media Studies*, 25(1) (2011), pp. 46–57.
- Cheney, G.R., Ruzzi, B.B. and Muralidharan, K., 'A Profile of the Indian Education System', Prepared for the New Commission on the Skills of the American Workforce, November 2005. Accessed at [www.skillscommission.org/study.htm](http://www.skillscommission.org/study.htm).
- Chernew, M.E., Hirth, R.A., Sonnad, S.S., Ermann, R., and Fendrick, A.M., 'Managed Care, Medical Technology, and Health Care Cost Growth: A Review of the Evidence', *Medical Care Research and Review* 55(3) (1998), pp. 259–88.
- CIPLA, About Us, History. Accessed 18 September 2014 at [www.cipla.com/Home/About-Us/History.aspx?mid=1289](http://www.cipla.com/Home/About-Us/History.aspx?mid=1289).
- Classified advertisement 1 – No title, *The Bombay Times and Journal of Commerce*, 21 February 1855, p. 113.

- Classified advertisement 2 – no title, *The Times of India*, 30 January 1967, p. 8.
- Classified advertisement 2 – no title, *The Times of India*, 25 November 1968, p. 3.
- Classified advertisement 4 – no title, *The Times of India*, 11 December 1961, p. 4.
- Classified advertisement 6 – no title, *The Times of India*, 24 September 1966, p. 11.
- Classified advertisement 7 – no title, *The Times of India*, 2 August 1967, p. 2.
- Classified advertisement 17 – no title, *The Times of India*, 20 May 1952, p. 8.
- Classified advertisement 19 – no title, *The Times of India*, 20 February 1972, p. 13.
- Classified advertisement 26 – no title, *The Times of India*, 27 October 1967, p. 6.
- Collen, M.F., ‘Origins of Medical Informatics’, *Western Journal of Medicine*, 145(6) (1986), pp. 778–85.
- Collier, L.H., ‘The Development of a Stable Smallpox Vaccine’, *Journal of Hygiene*, 53(01) (1955), pp. 76–101.
- ‘Colombo Plan for Development of Asian Countries: India To Incur Major Expenditure’, *The Times of India*, 29 November 1950, p. 1.
- Connelly, M.J., *Fatal Misconception: The Struggle to Control World Population* (Cambridge, 2008).
- ‘Control Measures and Industries: Plea to Sir A. Hydari’, *The Times of India*, 26 October 1945, p. 4.
- ‘Control of Drugs to Continue: No Imports Due To Lack Of Shipping’, *The Times of India*, 27 August 1945, p. 1.
- Cooter, R., Harrison, M. and Sturdy, S. (eds.), *Medicine and Modern Warfare* (Amsterdam, 1999).

- ‘Council for Social Development’, *India Social Development Report 2008: Development and Displacement* (New York, 2008).
- Cray, D.W., ‘Drug Industry Sees Ways to Make up for New-Product Lag’, *The New York Times*, 4 June 1967, p. 1.
- Dalton, D., *Mahatma Gandhi: Nonviolent Power in Action* (New York, 1993).
- Darby, J., *Dwight D. Eisenhower* (Minneapolis, 2004).
- Das, G., *India Unbound* (London, 2002).
- Das, T., ‘The Status of Hyderabad During and After British Rule in India’, *The American Journal of International Law*, 43(1) (1949), pp. 57–72.
- Dash, L.N., *World Bank and Economic Development of India* (New Delhi, 2000).
- Datt, G. and Ravallion, M., ‘Why Have Some Indian States Done Better Than Others at Reducing Rural Poverty?’ *Economica*, 65(257) (1998), pp. 17–38.
- DeLong, J.B., ‘India Since Independence: An Analytic Growth Narrative’, *In Search of Prosperity: Analytic Narratives on Economic Growth*, ed. D. Rodrik (Princeton, 2003).
- Devereux, S. and Berge, K., *Famine in the Twentieth Century* (Brighton, 2000).
- Devji, F., *The Impossible Indian: Gandhi and the Temptation of Violence* (Cambridge, 2012).
- Dharmarajan, S., ‘Cheaper Medical Aids Developed’, *The Times of India*, 4 November 1983, p. 7.
- Display Advertisement 14 – no title, *The Times of India*, 30 December 1948, p. 4.
- Donaldson, D., *Railroads of the Raj: Estimating the Impact of Transportation Infrastructure* (Working Paper No. w16487) (National Bureau of Economic Research, 2010).
- Dr. Reddy’s, India. Accessed 5 September 2014 at [www.drreddys.com/india/](http://www.drreddys.com/india/).
- ‘Drug Act to be Amended Soon’, *The Times of India*, 30 March 1982, p. 15.

- Dugger, C.W., 'Clinton Fever: A Delighted India Has All the Symptoms', *The New York Times*.
- Edquist, C. and Lundvall B.A., 'Comparing the Danish and Swedish Systems of Innovation' in Nelson, E., *National Innovation Systems: A Comparative Analysis* (Oxford, 1993), pp. 265-298.
- Egerton, A., 'Scientific Research in India', *Journal of the Royal Society of Arts*, 103(4962) (1955), pp. 799–825.
- Ehrmann, W.W., 'Post-War Government and Politics of India', *The Journal of Politics*, 9(4) (1947), pp. 653–91.
- Eikemo, T.A. and Bambra, C., 'The Welfare State: A Glossary for Public Health', *Journal of Epidemiology and Community Health*, 62 (1) (2008), pp. 3–6.
- Ekelman, K. (ed.), *New Medical Devices: Invention, Development, and Use* (Washington D.C., 1988).
- Ellis, R.P., Alam, M. and Gupta, I., 'Health Insurance in India: Prognosis and Prospectus', *Economic and Political Weekly* (35)4 (2000), pp. 207–17.
- 'English Doctor & Nurse Killed', *The Times of India*, 25 November 1947, p. 7.
- Eren-Vural, I., 'Domestic Contours of Global Regulation: Understanding the Policy Changes on Pharmaceutical Patents in India and Turkey', *Review of International Political Economy*, 14(1) (2007), pp. 105–42.
- Escobar, A., *Encountering Development: The Making and Unmaking of the Third World* (Princeton, 2012).
- Evans, A., 'Forecasting India's Potential', *The Round Table*, 93(376) (2004), pp. 595–608.
- Evenson, R.E., Pray, C.E. and Rosegrant, M.W., *Agricultural Research and Productivity Growth in India* (Vol. 109) (Washington D.C., 1999).

- Fang, Q., 'Host Range, Growth Property, and Virulence of the Smallpox Vaccine: Vaccinia Virus Tian Tan Strain', *Virology* (335)2 (2005), pp. 242–51.
- Farley, J., *To Cast Out Disease: A History of the International Health Division of Rockefeller Foundation* (Oxford, 2004).
- Feldman, H., 'Aid as Imperialism?' *International Affairs (Royal Institute of International Affairs 1944-)* (1967), pp. 219–35.
- Felker, G., Chaudhuri, S., and György, K., *The Pharmaceutical Industry in India and Hungary: Policies, Institutions, and Technological Development* (Vol. 392) (Washington, D.C.: World Bank Publications, 1997).
- Fenner, F., Henderson, D.A., Arita, I., et. al., *Smallpox and Its Eradication*, (Geneva: World Health Organization, 1988).
- Fenner, F., Henderson, D.A., Arita, I., Jezek, Z., and Ladnyi, I.D., 'Smallpox Vaccine and Vaccination in the Intensified Smallpox Eradication Programme', *Smallpox and its Eradication* (1988), pp. 539–92.
- Ferguson, D.P., 'From Communist Control to Glasnost and Back?: Media Freedom and Control in the Former Soviet Union', *Public Relations Review*, 24(2) (1998), pp. 165–182.
- Fischer, J., 'India's Insoluble Hunger', *John Harper's Magazine*, 1 April 1945, pp. 438–9.
- Fischer, W., 'Social Tensions at Early Stages of Industrialization', *Comparative Studies in Society and History*, 9(1) (1966), pp. 64–83.
- Frankel, F., *India's Political Economy: 1947–2004* (Oxford, 2005).
- 'Free Education for Women in Gujarat', *The Times of India*, 16 March 1971, p. 13.
- Freeman, C., "The 'National System of Innovation' in historical perspective." *Cambridge Journal of economics* 19(1), (1995), pp. 5-24.

- Friedman, L.J., *Charity, Philanthropy, and Civility in American History* (Cambridge, 2004).
- Fu, X. *China's Path to Innovation* (Cambridge University Press, 2015).
- Fu, X. (ed.). *China's Role in Global Economic Recovery* (Routledge, 2012).
- Fu, X., & Zhang, J. 'Technology Transfer, Indigenous Innovation and Leapfrogging in Green Technology: The Solar-PV Industry in China and India.' *Journal of Chinese Economic and Business Studies*, 9(4), (2011), pp. 329-347.
- Fu, X., Pietrobelli, C., and Soete, L., 'The Role of Foreign Technology and Indigenous Innovation in the Emerging Economies: Technological Change and Catching-up', *World Development*, (39) (2011), pp. 1204–12.
- Fukuda-Parr, S., Birdsall, N., Jahan, S., Fu, H., Noman, O., and Raworth, K., *Human Development Report 2001: Making New Technologies Work for Human Development* (New York: Oxford University Press for the United Nations Development Programme, 2001).
- Furman, J., Porter, M., and Stern, S., 'The Determinants of National Innovative Capacity', *Research Policy* 31 (2002) 899–933.
- 'Further Cut in Price: Retail Sale of Antibiotics', *The Times of India*, September 1959, p. 9.
- Gadgil, M. and Guha, R., *This Fissured Land: An Ecological History of India* (Berkeley, 1993).
- Gandhi, I., 'India and the World', *Foreign Affairs*, 51(1) (1972), pp. 65–77.
- Gerster, R., 'People Before Patents: The Success Story of the Indian Pharmaceutical Industry', *Bulletin von Medicus Mundi Schweiz*, (84) (2002), p. 5.
- 'Giant Drug Companies Exploiting Third World', *The Times of India*, 13 December 1982, p. 15.
- Goel, R., *Community Health Care* (New Delhi, 2002).
- 'Gokhale's Assurance to Pharmaceutical Units', *The Times of India*, 5 January 1973, p. 3.

- “Goondas” Fire on Police’, *The Times of India*, 14 August 1947, p. 7.
- Goshal, K., ‘As An Indian Sees It’, *The Pittsburgh Courier*, 31 July 1943, p. 6.
- Government of Rajasthan, Official Web Portal. Accessed 4 September 2014 at <http://rajasthan.gov.in/StateProfile/Pages/StateProfile.aspx>.
- Greenough, P., ‘Intimidation, Coercion and Resistance in the Final Stages of the South Asian Smallpox Eradication Campaign, 1973–1975’, *Social Science & Medicine*, 41(5) (1995), pp. 633–45.
- Greer, A.L., ‘Advances in the Study of Diffusion of Innovation in Health Care Organizations’, *The Milbank Memorial Fund Quarterly: Health and Society* (55)4 (1977), pp. 505–32.
- Greer, A.L., ‘Medical Technology: Assessment, Adoption, and Utilization’, *Journal of Medical Systems* 5(1-2) (1981), pp. 129–45.
- Grimes, W., ‘Foreign Aid: Indian Case History: Soviets Have Scored But U. Gains’, *The New York Times*, 21 February 1960, E5.
- Guha, R., *India after Gandhi* (New Delhi, 2007).
- ‘Gujerat & Kathiawar Scheme of Attachment Ends’, *The Times of India*, 14 August 1947, p. 1.
- Gupta, A., Trivedi, M., and Kandamuthan, S., *Option of Healthcare Technologies in India: Implications for the AIDS Vaccine* (New Delhi, 2007).
- Gupta, J.B.D. (ed.), *Science, Technology, Imperialism, and War* (New Delhi, 2007).
- Gupte, D.G., ‘Reverberations in Global Market After Elections: Money and Banking’, *The Times of India*, December 3, 1989, p. 12.
- Gwatkin, D.R., ‘Political Will and Family Planning: The Implications of India’s Emergency Experience’, *Population and Development Review*, 5(1) (1979), pp. 29–59.

- Gwertzman, B., 'US Offers Pakistan \$400 Million in Aid to Counter Soviet', *The New York Times*, 14 January 1980, A1.
- Haley, G.T. and Haley, U.C.V., 'The Effects of Patent-Law Changes on Innovation: The Case of India's Pharmaceutical Industry', *Technological Forecasting and Social Change*, 79 (4) (2012), pp. 607–19.
- Hall, W.A., 'Medical Complex Could Breathe Life into Newburgh's West Street', *The Times Herald-Record*, 27 July 2000. Accessed 8 August 2014 at [www.recordonline.com](http://www.recordonline.com).
- Hardiman, D., ed., *Healing Bodies, Saving Souls: Medical Missions in Asia and Africa* (London, 2006).
- Hardiman, D., *Missionaries and their Medicine, A Christian Modernity for Tribal India* (New York, 2008).
- Hardiman, D. and Mukharji, P.B. (eds.), *Medical Marginality in South Asia: Situating Subaltern Therapeutics* (New York, 2013).
- Harries, J.M. and Hollingsworth, D.F., 'Food Supply, Body Weight, and Activity in Great Britain, 1943–9,' *British Medical Journal*, 1(4801) (1953), pp. 75–8.
- Harrington, M., 'From HIV to Tuberculosis and Back Again: A Tale of Activism in Two Pandemics', *Clinical Infectious Diseases*, 50(Supplement 3) (2010), pp. S260–S266.
- Harris, G., 'Medicines Made in India Set Off Safety Worries', *The New York Times*, 12 February 2014. Accessed at [www.nytimes.com/2014/02/15/world/asia/medicines-made-in-india-set-off-safety-worries.html](http://www.nytimes.com/2014/02/15/world/asia/medicines-made-in-india-set-off-safety-worries.html).
- Harrison, M., Jones, M. and Sweet, H. (eds.), *From Western Medicine to Global Medicine: The Hospital Beyond the West* (Hyderabad, 2009).

- Harrison, M., *Medicine and Victory: British Military Medicine in the Second World War* (Oxford, 2004).
- Harrison, M., *Public Health in British India: Anglo-Indian Preventive Medicine, 1859–1914* (Cambridge, 1994).
- Harrison, M., *Public Health and Preventive Medicine in British India, 1859-1914* (Cambridge, 2004).
- Hartford, T., ‘India’s Crisis of Confidence’, *Guardian*, 6 December 1966, p.8.
- Haynes, D.M., *Imperial Medicine: Patrick Manson and the Conquest of Tropical Disease* (Philadelphia, 2001).
- Hazarika, S., ‘India Does an About-Face and Courts the Drug Industry’, *The New York Times*, 20 June 1988, D5.
- Headrick, D.R., *The Tentacles of Progress: Technology Transfer in the Age of Imperialism* (New York, 1988).
- Headrick, D.R., *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (New York, 1981).
- ‘Health Services’, *Times of India*, 31 July 1957, p. 6.
- Helleiner, G.K., ‘Manufactured Exports from Less-developed Countries and Multinational Firms’, *The Economic Journal*, 83(329) (1973), pp. 21–47.
- Helleiner, G.K., ‘Manufacturing For Export, Multinational Firms and Economic Development’, *World Development*, 1(7) (1973), pp. 13–21.
- Henderson, D.A., *Smallpox: The Death of a Disease: The Inside Story of Eradicating a Worldwide Killer* (Amherst, 2009).

Henderson, D.A., 'The Eradication of Smallpox – An Overview of the Past, Present, and Future', *Vaccine*, (2011), pp. D7–D9.

Henige, D.P., *The Princely States of India: A Chronological Checklist of Their Rulers* (New York, 1997).

Hewa, S. and Stapleton, D., eds., *Globalization, Philanthropy, and Civil Society: Toward a New Political Culture in the Twenty-First Century* (New York, 2005).

Hill, A.V., *Biographical Memoirs of Fellows of the Royal Society*, 1(71) (1945).

Holland, H., *Frontier Doctor: An Autobiography* (London, 1958).

IBM Global Workforce in 2010. Accessed at [www.ibm.com/annualreport/2010/financial-highlights.html](http://www.ibm.com/annualreport/2010/financial-highlights.html).

'Import of Drugs and Medicines', *The Times of India*, 17 January 1948, p. 4.

'Increasing American Aid to our Country', *The Times of India*, 9 December 1959, p. 18.

'India, GDR Sign Trade Tie-up Period', *The Times of India*, 18 October 1973, p. 5.

'India Bans Imports of Certain Items', *The New York Times*, 4 July 1965, p.1.

India Brand Equity Foundation. Accessed at [www.ibef.org/industry.aspx](http://www.ibef.org/industry.aspx).

'India Liberalizes Imports Policy in an Effort to Spur Protection', *The New York Times*, 28 April 1977, p. 93.

'India Must Hasten Technological Revolution – Indira', *The Times of India*, 8 September 1967, p. 9.

'India's Chromite resources', *The Times of India*, 8 August 1945, p. 8.

'India's Health Budget Cut', *The Times of India*, 10 November 1949, p. 9.

'India's Scientific Needs Prof. Hill's Recommendations', *The Scotsman*, 1 February 1945, p. 8.

'Indian Drug Makers Hail New Patent Law', *The Times of India*, 17 September 1970, p. 4.

- ‘Indian Patents & Designs: Bill Passed’, *The Times of India*, 13 November 1952, p. 9.
- Indian Pharmaceutical Association. Accessed 11 August 2014 at <http://ipapharma.org/Home.aspx>.
- ‘Indian Policy in Foreign Affairs: Avoiding Rival Blocks’, *Manchester Guardian*, 18 September 1950, p. 8.
- Iyengar, S.D., Iyengar, K. and Gupta, V., ‘Maternal Health: A Case Study of Rajasthan’, *Journal of Health, Population and Nutrition*, 27(2) (2009), pp. 271–92.
- Janjua, S.S., ‘Communalism in India’, *Social Policy and Administration in India* (1996), p. 201.
- ‘Japan Attacks Indian Move for Patent Law’, *The Times of India*, 14 September 1967, p. 9.
- Jefferey, R., ‘Policies Towards Indigenous Healers in Independent India’, *Social Science & Medicine*, 16(21) (1982), pp. 1835–41.
- Jeffery, R., ‘Allopathic Medicine in India: A Case of Deprofessionalization?’, *Social Science & Medicine*, 11(10) (1967), pp. 561–73.
- Jeffery, R., ‘New Patterns in Health Sector Aid’, *Economic and Political Weekly*, 17(37) (1982), pp. 1495–1503.
- Jeffery, R. and Santhosh, M.R., ‘Architecture of Drug Regulation in India’, *Journal of Health Studies* (2009), pp. 13–32.
- Jeffrey, R., ‘Culture of Daily Newspapers in India: How it’s Grown, What it Means’, *Economic and Political Weekly*, 22(14) (1987), pp. 607–11.
- Jha, L.K., Lecture – ‘Technology and Development’, 19 February 1982. Accessed 17 August 2013 at [www.nfdindia.org/lec8.htm](http://www.nfdindia.org/lec8.htm).
- ‘Joint Committee Cuts Period: Patent rights’, *The Times of India*, 28 February 1970, p. 11.
- Jones, M.M., *The American Red Cross from Clara Barton to the New Deal* (Baltimore, 2013).

- Kaarthikenyam, D.R. and Raju, R., *Rajiv Gandhi Assassination* (New Delhi, 2008).
- Kandell, J., 'Drug Marketers Stir Bitter Debate in Brazil', *The Times of India*, 14 November 1976, p. 3.
- Kasilingam, R. and Jayabal, G., 'Savings in India-A Critical Analysis', *Journal of Contemporary Research in Management*, 4(1) (2009), pp. 113–23.
- Kaviraj, S. 'Crisis of the Nation-State in India', *Political Studies*, 42(s1) (1994), pp. 115–29.
- Kaviraj, S., 'Indira Gandhi and Indian Politics', *Economic and Political Weekly*, (1986), pp. 1697–1708.
- Keir, D., 'Western Medicine in the Modern World', *The Lancet*, 264(6843) (1954), pp. 823–5.
- Khadria, B., 'International Nurse Recruitment in India', *Health Services Research*, 42(3p2) (2007), pp. 1429–36.
- Kher, B.G., 'Our New India', *The Times of India*, 3 August 1947, p. 8.
- Khor, M., 'The Man Who Saved Millions with Cheap Medicines', *Third World Network*, August 2013. Accessed at [www.twinside.org.sg/twnf/2013/3985.htm](http://www.twinside.org.sg/twnf/2013/3985.htm).
- Khrushchev, S., (ed.), *Memoirs of Nikita Khrushchev* (Vol. 3) (University Park, 2007).
- Kochanek, S.A., 'India's Changing Role in the United Nations', *Pacific Affairs*, (1980), pp. 48–68.
- Kohli, A., 'Politics of Economic Liberalization', *World Development*, (17)3 (1989), pp. 305–28.
- Kohli, A., ed., *The Success of India's Democracy* (Cambridge, 2001).
- Kotkin, S., *Armageddon Averted: Soviet Collapse, 1970–2000* (New Delhi, 2008).
- Kroker, K., Mazumdar, P.M.H., and Keelan, J.E. (eds.), *Crafting Immunity: Working Histories of Clinical Immunology* (Hampshire, 2008), p. 291.
- Kulkarni, Y.S., 'Drug Imports: To The Editor', *The Times of India*, 2 April 1948, p. 6.

- Kumar, R., *The History of Doing: An Illustrated Account of Movements for Women's Rights and Feminism in India 1800–1990* (New Delhi, 1997).
- Kumar, D. (ed.), *Science and Empire: Essays in Indian Context, 1700-1947* (New Delhi, 1991).
- Kumar, D., *The Cambridge Economic History of India, Volume II: c. 1757–2003* (New Delhi, 1983).
- Kuruvilla, S., 'Linkages Between Industrialization Strategies and Industrial Relations/Human Resource Policies: Singapore, Malaysia, the Philippines, and India', *Industrial and Labour Relations Review* (1996), pp. 635–57.
- Lall, D., *The Hindu Equilibrium* (New York, 2004).
- Lanjouw, J.O., 'The Introduction of Pharmaceutical Product Patents in India: "Heartless Exploitation of the Poor and Suffering"?' Economic Growth Center, Yale University, Center Discussion Paper No. 775 (1998). Accessed at:  
<http://ageconsearch.umn.edu/bitstream/28385/1/dp970775.pdf>
- 'Late News', *The Times of India*, 14 August 1946, p. 1.
- Lehmann, D. (ed.), *Development Theory: Four Critical Studies* (New York, 2011).
- Leslie, C.M. and Young, A. (eds.), *Paths to Asian Medical Knowledge* (No. 32) (Berkeley and Los Angeles, 1992).
- 'Leucoderma Drug in India Soon', *The Times of India*, 29 November 1989, p. 5.
- Lourdusamy, J., *Science and National Consciousness in Bengal: 1870-1930* (Vol. 8) (New Delhi, 2004).
- Lundvall, B.A., *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*, (Vol. 2) (London, 2010).
- Machiavelli, N., *The Prince* (Translated with an Introduction by George Bull) (London, 1961).

- MacLeod, R.M., 'Scientific Advice for British India: Imperial Perceptions and Administrative Goals, 1898–1923', *Modern Asian Studies* 9(3) (1975), pp. 343–84.
- Macleod, R.M. and Kumar, D. (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India, 1700-1947* (New Delhi and London, 1995).
- Mahal, A. and Mohanan, M., 'Growth of Private Medical Education in India', *Medical Education*, 40(10) (2006), pp. 1009–11.
- Mahal, A., Varshney, A., and Taman, S., 'Diffusion of diagnostic medical devices and policy implications for India', *International Journal of Technology Assessment in Health Care*, (22)2 (2006), pp. 184–90.
- Maharashtra State Pharmacy Council. Accessed 21 July 2014 at [www.mspsindia.org/General/PharmIndia.aspx](http://www.mspsindia.org/General/PharmIndia.aspx).
- Majumdar, S.K., *India's Late, Late Industrial Revolution: Democratizing Entrepreneurship* (Cambridge, 2012).
- Malenbaum, W., 'Industrialization in India's Development', *Wilfred Current History*, 44(259) (1963), pp. 167–73.
- Malerba F., *Sectoral Systems of Innovation: Concepts, Issues, and Analyses of Six Major Sectors in Europe* (Cambridge, 2004).
- Malone, B., "'Telemedicine' links Africans to Indian expertise", *Reuters*, 3 April 2008. Accessed at [www.reuters.com/article/2008/04/03/us-africa-india-hospitals-idUSL015117720080403](http://www.reuters.com/article/2008/04/03/us-africa-india-hospitals-idUSL015117720080403).
- Mani, S., 'Has India Become More Innovative Since 1991? Analysis of the Evidence and Some Disquieting Features', Working Paper 415 (2009). Accessed at [http://opendocs.ids.ac.uk/opendocs/handle/123456789/3132#.U0wPeiLD\\_ct](http://opendocs.ids.ac.uk/opendocs/handle/123456789/3132#.U0wPeiLD_ct).

- ‘Manmohan Favours Structural Reform’, *The Times of India*, 6 July 1991, p. 1.
- Masani, M.R., *The Communist Party of India: A Short History* (London, 1954).
- Matsaganis, M., Ferrera, M., Capucha, L., and Moreno, L., ‘Mending Nets in the South: Anti-poverty Policies in Greece, Italy, Portugal, and Spain’, *Social Policy & Administration*, 37(6) (2003), pp. 639–55.
- Mayhew, A., ‘Clarence Ayres, Technology, Pragmatism, and Progress’, *Cambridge Journal of Economics* 34(1) (2010), pp. 213–22.
- Mazumdar, M., *Performance of Pharmaceutical Companies in India*, (New York, 2013).
- Mckie, J., ‘Management of Medical Technology in Developing Countries’, *Journal of Biomedical Engineering* 12(3) (1990), pp. 259–61.
- McComas, T., ‘Mythology Wars, The Indian Diaspora and Debating the Hindu Past’, *Asian Studies Review* (35)2 (2011).
- ‘Medical Aid in India: Objectives of New Institute’, *The Hindu*, 5 April 1952, p. 4.
- Medical Council of India. Accessed 30 August 2013 at [www.mciindia.org/](http://www.mciindia.org/).
- ‘Medical Institute in Delhi’, *The Times of India*, 5 April 1952, p. 7.
- ‘Medical Studies in India: Need to Improve Standards’, *The Times of India*, 21 April 1952, p. 5.
- ‘Medicines and Drugs Import: Jap Mission’s Offer’, *The Times of India*, 11 February 1954.
- Mehrotra, S.K., *India and the Soviet Union: Trade and Technology Transfer* (No. 73) (New York, 1990).
- Menachemi, N., Burke, D.E. and Ayers, D.J., ‘Factors Affecting the Adoption of Telemedicine—a Multiple Adopter Perspective’, *Journal of Medical Systems* (28)6 (2004), pp. 617–32.

‘Merck & Co. and Tata of India to Form Drug Manufacturing Concern at Bombay’, *The Times of India*, 4 November 1958, p. 36.

Meyer, J.B. and Brown, M., ‘Scientific Diasporas: A New Approach to the Brain Drain’, *Management of Social Transformations (MOST) Programme* (1999). Accessed at [www.unesco.org/most/meyer.htm](http://www.unesco.org/most/meyer.htm).

‘Micro-slides Sent Abroad: Poona Venture: “Times of India” News Service’, *The Times of India*, 14 August 1967, p. 8.

Midtgaard, K., ‘National Security and the Choice of International Humanitarian Aid: Denmark and the Korean War, 1950–1953’, *Journal of Cold War Studies*, 13(2) (2011), pp. 148–74.

Miller, D. and Garnsey, E., ‘Entrepreneurs and Technology Diffusion: How Diffusion Research Can Benefit from a Greater Understanding of Entrepreneurship’, *Technology in Society*, 22(4) (2000), pp. 445–65.

‘Ministries Divided on Patent Bill’, *The Times of India*, 13 February 1964, p. 3.

Mishra, A.D., *Revisiting Hind Swaraj* (New Delhi, 2010).

‘Missionaries Facing New Curbs in India’, *The New York Times*, 19 May 1954, p. 4.

M.K. Gandhi, *Hind Swaraj*, Indian Opinion, 36.

‘Modern and Indigenous Medicines: Dr. Rao Advocates “Co-Existence”’, *The Times of India*, 27 December 1956, p. 11.

‘Modern Medicine and Ayurveda: Minister calls for Synthesis’, *The Times of India*, 23 December 1956, p. 9.

- Mohan, R. and Aggarwal, V., 'Commands and Controls: Planning for Indian Industrial Development, 1951–1990', *Journal of Comparative Economics*, 14(4) (1990), pp. 681–712.
- Moore, A., 'India's Market for Industrial Goods Realistic Approach Could Build Sound, Profitable Exchange of Goods', *Barron's National Business and Financial Weekly*, 1 July 1946, p. 11.
- 'Morarji Desai Elected Prime Minister - New Cabinet Announced - Initial Differences Resolved', *India – West*, 1 April 1977.
- '"More Elbow Room for Large Units" Growth', *The Times of India*, 3 February 1973, p. 1.
- Morehouse, W., (ed.), *Science and the Human Condition in India and Pakistan* (Vol. 69) (New York, 1968).
- Motiwalla, M., 'A Career in a Test Tube', *The Times of India*, 4 October 1953, A3.
- Mourshed, M. 'Technology Transfer Dynamics: Lessons from the Egyptian and Indian Pharmaceutical Industries' (Massachusetts Institute of Technology, PhD thesis, 1999).
- 'Move For All-India Medical Institute At Delhi: Rajkumari Amrit Kaur on Scope of Dentist's Bills', *The Times of India*, 20 February 1948, p. 7.
- 'Mr. Gandhi's House Stoned By Mob', *The Times of India*, 14 August 1947, p 1.
- 'Mrs. Pandit at Kremlin', *The Times of India*, 15 August 1947, p 5.
- Muppidi, H., 'Postcoloniality and the Production of International Insecurity: The Persistent Puzzle of US-Indian Relations', *Cultures of insecurity: States, communities, and the production of danger* (Minneapolis, 1999), pp. 119–46.

- Mueller, J.M., 'The Tiger Awakens: the Tumultuous Transformation of India's Patent System and the Rise of Indian Pharmaceutical Innovation', *University of Pittsburgh Law Review*, 68(3) (2007), pp. 491–641.
- Mukherji, J.N., 'Modern Science In India: Significance of Indo-British Congress', *The Times of India*, 16 December 1937, p. 4.
- Nair, A. 'Drug Prices: To the Editor, The Times of India', *The Times of India*, 4 October 1973, p. 4.
- 'Natural Resources of India: Pleas for Exploitation A Special Correspondent', *The Times of India*, 26 February 1938, p. 16.
- Nayaka, J.P. and Nurullah, S., *A Students' History of Education in India (1800–1973)* (Delhi, 1974).
- Nayar, B.R., 'Globalisation and India's National Autonomy', *Commonwealth and Comparative Politics* 41(2) (2003), pp. 1–34.
- “‘Need for State Control of All Industries Bombay Plan Authors’ Memorandum”, *The Times of India*, 17 January 1945, p. 5.
- Nehru, P., 'Speeches Made by Eisenhower and Nehru in New Delhi', *The New York Times*, 12 December 1959, p. 10.
- Nell, K.S., 'An Alternative Explanation of India's Growth Transition: A Demand-Side Hypothesis', *Cambridge Journal of Economics* 37(1) (2013), pp. 113–41.
- Nelson, R. R. 'National Innovation Systems: A Retrospective on a Study', *Institutional and Corporate Change* 1(2), (1992), pp. 347-374.
- 'New Television Advance: 605 Line Screen in USA', *The Times of India*, 9 April 1940, p. 10.

- Nichter, M., 'Vaccinations in the Third World: A Consideration of Community Demand', *Social Science & Medicine*, 41(5) (1995), pp. 617–32.
- Nichter, M. and Vuckovic, N., 'Agenda for an anthropology of pharmaceutical practice', *Social Science & Medicine*, 39(11) (1994), pp.1509–25.
- 'No Theocratic State Envisaged for India', *The Times of India*, 26 January 1948, p. 8.
- Norman, W.R., 'Boots Pure Drug Co Ltd: Timothy Whites Integration Gives ... High Hopes for the Future', *Guardian*, 27 June 1969, p. 18.
- 'Oral Cholera Vaccine for Field Trials', *The Times of India*, 21 October 1968, p. 11.
- 'Oral Contraceptive Under Trial', *The Times of India*, 28 July 1971, p. 14.
- Padmanabhan, S.Y., 'The Great Bengal Famine', *Annual Review of Phytopathology*, 11 (1973), pp. 11–24.
- 'Pakistan's First Cabinet: Eleventh-Hour Change', *The Times of India*, 14 August 1947, p. 1.
- Palande, P.S., Shah, R.S. and Lunawat, M.L., *Insurance in India: Changing Policies and Emerging Opportunities* (New Delhi, 2003).
- Panagariya, A., *India: The Emerging Giant* (New Delhi, 2008).
- Panagariya, A., 'The Triumph of India's Market Reforms: The Record of the 1980s and 1990s', *Policy Analysis*, (7 November 2005).
- Papageorgiou, C., Savvides, A. and Zachariadis, M., 'International Medical Technology Diffusion', *Journal of International Economics*, 72(2) (2007), pp. 409–27.
- Park, J.E., *Textbook of Preventive and Social Medicine: A Treatise on Community Health*, (3rd ed.) (Prem Nagar, 1972).
- Parker, R., 'Soviet Aid for Pharmaceutical Plant Project: Indian Team Signs Pact in Moscow, 80 Million Rouble Credit Offered', *The Times of India*, 30 May 1959, p. 1.

- ‘Patent Folly’, *The Times of India*, 16 December 1964, p. 8.
- ‘Patent Law: To the Editor’, *The Times of India*, 20 January 1965, p. 8.
- ‘Patents Bill Passed: Unanimously by Lok Sabha’, *The Times of India*, 30 August 1970, p. 6.
- ‘Patents Committee’, *The Times of India*, 19 April 1949, p. 4.
- Pattanayak, S., Arora, D.D., Sehgal, C.L., Raghavan, N.G.S., Topa, P.K., and Subrahmanyam, Y.K., ‘Comparative Studies of Smallpox Vaccination by the Bifurcated Needle and Rotary Lancet Techniques’, *Bulletin of the World Health Organization*, 42(2) (1970), pp. 305–10.
- Peppin Vaughan, R., ‘Complex Collaborations: India and International Agendas on Girls’ and Women’s Education, 1947–1990’, *International Journal of Educational Development*, 33(2) (2013), pp. 118–29.
- Peter, V.M., Keer, I.A. and Thorpe, M., ‘Tax Policy in India’, *Asian Journal of Public Administration*, 24(1) (2002), pp. 111–38.
- Peters, D.H. (ed.), *Better Health Systems for India’s Poor: Findings, Analysis, and Options*, (World Bank Publications, 2002).
- Pilisuk M. and Hayden, T., ‘Is there a Military Industrial Complex Which Prevents Peace?: Consensus and Countervailing Power in Pluralistic System’, *Journal of Social Issues* 21(3) (1965), pp. 67–117.
- ‘Plan to Develop Drug Industry: Minister Meets Soviet Experts’, *The Times of India*, 6 August 1958, p. 7.
- Porter, A., *Religion Versus empire? British Protestant Missionaries and Overseas Expansion, 1700-1914* (Manchester, 2004).

- Porter, A.N. (ed.), *The Imperial Horizons of British Protestant Missions, 1880-1914* (Grand Rapids, 2003).
- Porter, D. (ed.), *The History of Public Health and the Modern State* (Vol. 26) (Amsterdam, 1994).
- Porter M. and Kramer, M., 'The Competitive Advantage of Corporate Philanthropy', *Harvard Business Review*, 80(12), (2002), pp. 56-68.
- 'Practical Value of Freedom', *The Times of India*, 27 January 1948, p. 3.
- Prakash, G., *Another Reason: Science and the Imagination of Modern India* (Princeton, 1999).
- Prakash, G., 'Science, Technology and Medicine in Colonial India (review)', *Victorian Studies*, 45(1) (2002), pp. 149–51.
- Prime, P.B., Subrahmanyam, V. and Lin, C.M., 'Competitiveness in India and China: The FDI Puzzle', *Asia Pacific Business Review*, 18(3) (2012), pp. 303–33.
- 'Production of Drugs', *The Times of India*, 26 May 1954, p. 13.
- 'Promising Trend in Drugs and Chemicals', *The Times of India*, 20 April 1961, p. 1.
- Railston, W., 'Britain and the Technical Development of Eastern Commonwealth Countries under the Colombo Plan', *Journal of the Royal Society of Arts*, (1959), pp. 652–66.
- Rajiv Gandhi Centre for Biotechnology. Accessed 5 September 2014 at [www.rgcb.res.in/profile.shtml](http://www.rgcb.res.in/profile.shtml).
- Rakshit, M., *Macroeconomics of Post-Reform India: Selected Papers, Volume I*, (OUP Catalogue: Oxford, 2008).
- Rallis India Limited. Accessed at [www.rallis.co.in/aboutus/history.asp](http://www.rallis.co.in/aboutus/history.asp).
- 'Rallis India Poised for Development', *The Times of India*, 19 January 1973, p. 4.

- Ramani, S.V. and Venkataramani, M.S., 'Rising to the Technological Challenge: Possibilities for Integration of Biotechnology in the Indian Pharmaceutical Industry', *International Journal of Biotechnology*, 3(1) (2001), pp. 95–115.
- Rangan, K., 'India Presses Technical Studies under a "Nationalist" Program', *The New York Times*, 13 January 1965, p. 85.
- Rangnekar, D., 'No Pills for Poor People? Understanding the Disembowelment of India's Patent Regime', *Economic and Political Weekly*, 41(5) (2006), pp. 409–17.
- Rao, C.N.R., 'Science and Technology Policies: The Case of India', *Technology in Society*, 30(3) (2008), pp. 242–47.
- Rao, P.R., 'India: Science and Technology from Ancient Time to Today', *Technology in Society*, 19(3–4) (1997), pp. 415–47.
- Ravallion, M. and Datt, G., 'India's Checkered History in Fight against Poverty: Are There Lessons for the Future?', *Economic and Political Weekly* (1996), pp. 2479–85.
- Ravindranath, P.K., *The Indian Pharmaceutical Industry Since Independence* (Delhi, 2001).
- Redfield, P., *Life in Crisis: The Ethical Journey of Doctors without Borders* (Berkeley and Los Angeles, 2013).
- Relman, A.S., 'The New Medical–Industrial Complex', *The New England Journal of Medicine*, 303(17) (1980), pp. 963–70.
- Rist, G., *The History of Development: From Western Origins to Global Faith* (London and New York, 2002).
- 'Riots Break Out in Alwar Town', *The Times of India*, 15 August 1947, p. 16.
- 'Rockefeller Grants of Over One Million Dollars', *The Times of India*, 17 August 1956, p. 11.
- Rogers, E.M., *Diffusion of Innovations*, 5th ed. (New York, 2003).

Rosen, M., 'Global Medical Device Market Outperforms Drug Market Growth', (Madison, WTNNews, 2008). Accessed 10 July 2012 at <http://wistechnology.com/articles/4790/>.

Rothermund, D., *An Economic History of India* (New York, 1988).

Rothermund, D., *India: The Rise of an Asian Giant* (New Haven and London, 2008).

Rout, H.S., *Health Economics in India* (New Delhi, 2007).

Roy, T., *The Economic History of India 1857–1947*, (New Delhi, 2000).

Sabharwal, G., *India Since 1947: The Independent Years* (New Delhi, 2007).

Sachidananda, 'National vs. International', *The Times of India*, 20 September 1990, p. 15.

Sahu, S.K., *Technology Transfer, Dependence, and Self-Reliance Development in the Third World: The Pharmaceutical and Machine Tool Industries in India* (Santa Barbara, 1998).

Sahu, S.K., 'Globalization and the Indian Pharmaceutical Industry', *International Political Science Organization* (2015). Accessed at [http://paperroom.ipsa.org/papers/paper\\_196.pdf](http://paperroom.ipsa.org/papers/paper_196.pdf).

Sarkar, P.K., 'A Rational Drug Policy', *Indian Journal of Medical Ethics* (2004), pp. 11-2.

Sauro, W.E., 'India Curbs Patents: New Law Upsets Some US Companies', *The New York Times*, 15 November 1970, F14.

*Search results – News & newspapers – ProQuest for 'medical device'* (2013). Accessed at <http://search.proquest.com>.

*Search results – News & newspapers – ProQuest for 'medical technology'* (2013). Accessed at <http://search.proquest.com>.

Seers, D., *The Meaning of Development* (New Delhi, 1969).

- Sen Gupta, A.K. and Sett, P.K., 'Industrial Relations Law, Employment Security and Collective Bargaining in India: Myths, Realities and Hopes', *Industrial Relations Journal*, 31(2) (2000), pp. 144–53.
- Şenel, E., 'History of Teledermatology: A Technique of the Future in Dermatology', *Skinmed*, 8(3) (2010), pp. 167–69.
- Shah, A., *Vikram Sarabhai: A Life* (New Delhi, 2007).
- Sharma, U.K., Pegu, S., Hazarika, D., and Das, A 'Medico-Religious Plants Used by the Hajong Community of Assam, India', *Journal of Ethnopharmacology*, 143(3) (2012), pp. 787–800.
- Sheehan, H.E. and Hussain, S.J., 'Unani Tibb: History, Theory, and Contemporary Practice in South Asia', *The ANNALS of the American Academy of Political and Social Science*, 583(1) (2002), pp.122–35.
- Shridharani, K., 'India in a Changing Asia', *Pacific Affairs* 14(1) (1941), pp. 5–20.
- Shukla, V. (ed.), *Communalism in India* (Gurgaon, 2008).
- Sikri, A., 'India Approves Use of U.S. drug', *India Abroad*, 28 December 1990.
- Singh, A.I., 'The Soviet Union and India: A bibliographical Review of Writing in English', *The Journal of Communist Studies and Transition Politics*, (4)3 (1988), pp. 301–26.
- Singh, R., 'India's Physics and Chemistry Nobel Prize Nominators and Nominees in Colonial and International Context', *Notes and Records of the Royal Society*, 61(3) (2007), pp. 333–45.
- Snellen, T.M. and van de Donk, W.B.H.J., *Expert Systems in Public Administration: Evolving Practices and Norms* (Amsterdam, 1989), cited in Lundvall, B.A., *National Systems of*

- Innovation: Toward a Theory of Innovation and Interactive Learning*, (Vol. 2) (London, 2010), p. 137.
- Soaring Prices of Foodstuffs: Rise In Cost of Living,' *The Time of India*, 11 February 1947, p. 5.
- Spear, P., 'Nehru', *Modern Asian Studies*, 1(1) (1967), pp. 15–29.
- Sreedharan, S.K., 'On the Road to Commercialization of Patents in India', *Journal of Intellectual Property Law & Practice*, 7(2) (2012), pp. 112–18.
- Srinivas, S., 'Technological Learning and the Evolution of the Indian Pharmaceutical and Biopharmaceutical Sectors', (Massachusetts Institute of Technology PhD Thesis, 2004).
- Srinivas, S., *Market Menagerie: Health and Development in Late Industrial States* (Palo Alto, 2012).
- Srinivasan, T.N., 'China and India: Economic Performance, Competition and Cooperation: An Update', *Journal of Asian Economics*, 15(4) (2004), pp. 613–36.
- Stanton, J. (ed.), *Innovations in Health Medicine: Diffusion and Resistance in the Twentieth Century* (New York, 2002).
- 'Steady Progress Maintained By CIPLA: Dr. K.A. Hamied on Future of CIPLA', *The Times of India*, p. 5.
- Stein, B., *A History of India* (Oxford, 2010).
- Stephens, R., 'Russian Activity in India', *The Observer*, 22 April 1951, p. 3.
- Stevenson, R., *Bengal Tiger and British Lion: An Account of the Bengal Famine of 1943* (Lincoln, 2005).
- Stewart, A.J. and Devlin, P.M., 'The History of the Smallpox Vaccine', *Journal of Infection*, 52(5) (2006), pp. 329–34.
- Stone, D., ed., *The Oxford Handbook of Postwar European History*, (Oxford, 2012).

‘Study of Pharmaceutical Production in Russia: Indian Delegation’s Tour’, *The Times of India*, 10 August 1956, p. 11.

Subbarayappa, B.V., ‘Siddha medicine: An Overview’, *The Lancet*, 350(9094) (1997), pp. 1841–44.

‘Substandard Colleges are “Major Malady”’, *The Times of India*, 1 August 1965, p. 9.

Sun Pharma, History. Accessed 5 September 2014 at [www.sunpharma.com/history](http://www.sunpharma.com/history).

Supe, A. and Burdick, W.P., ‘Challenges and issues in medical education in India’, *Academic Medicine*, 81(12) (2006), pp. 1076–80.

Svoboda, R., *Ayurveda: Life, Health and Longevity* (New Delhi, 1992).

Tata Institute of Fundamental Research. Accessed at [www.tifr.res.in/index.php/about-us/general-info/history.html](http://www.tifr.res.in/index.php/about-us/general-info/history.html).

Taylor, F., *The Principles of Scientific Management* (London, 1911).

Technology [Def. 1]. (n.d.), *Oxford Dictionary Online*. Accessed 11 September 2013 at [www.oxforddictionaries.com/defintion/technology](http://www.oxforddictionaries.com/defintion/technology).

‘Ten Years of Economic Aid: Russians Thanked’, *The Times of India*, 2 February 1965, p. 7.

Thakur, R., ‘Restoring India’s Economic Health’, *Third World Quarterly*, 14(1) (1993), pp. 137–57.

Thandavan, R., ‘Hindu Political Expression: RSS in India’, *The Indian Journal of Political Science*, 48(3) (1987), pp. 428–33.

Tharoor, S., *Nehru: The Invention of India* (New York, 2003).

The Cold War Museum. Accessed 29 July 2014 at [www.coldwar.org/articles/90s/fall\\_of\\_the\\_soviet\\_union.asp](http://www.coldwar.org/articles/90s/fall_of_the_soviet_union.asp).

The Henry J. Kaiser Family Foundation, 'Snapshots: How Changes in Medical Technology Affect Health Care Costs', 2 March 2007. Accessed at [kff.org/health-costs/issue-brief/snapshots-how-changes-in-medical-technology-affect/](http://kff.org/health-costs/issue-brief/snapshots-how-changes-in-medical-technology-affect/).

*The Medical Technology Complex Building Project for a Hospital in Shanghai* (2013). Accessed at <http://en.topbm.com>.

'The Refugees: A Problem that Must be Solved', *The Times of India*, 13 October 13, 1947, p. 6.

Thelikorala, S., 'Indira Gandhi: Iron Lady of India', *Asian Tribune*, 19 November 2011. Accessed at [www.asiantribune.com/news/2011/11/18/indira-gandhi-iron-lady-india](http://www.asiantribune.com/news/2011/11/18/indira-gandhi-iron-lady-india).

'Third World to End Drug Monopoly', *The Times of India*, 13 September 1976, p. 9.

Tilak, J.B.G., 'Emerging Trends and Evolving Public Policies in India', *Private Prometheus: Private Higher Education and Development in the 21st Century* (Westport, 1999), pp. 113–35.

Tirthankar, R., *The Economic History of India: 1857–1947* (New Delhi, 2000).

Tomlinson, B.R., *The Economy of Modern India: From 1860 to the Twenty-first Century* (Vol. 3) (Cambridge, 2013).

Tomlinson, B.R. *The Economy of Modern India, 1860-1970*, Vol. 3 (Cambridge University Press, 1996).

Tomlinson, B.R. 'Foreign Private Investment in India 1920–1950', *Modern Asian Studies*, 12(04), (1978), pp. 655-677.

'Transcript of President Eisenhower's Press Conference, with comment on Indo-China', *The New York Times*, 8 April 1954, p. 18.

'Trends in Medical Diagnosis in India', *The Times of India*, 17 December 1991, p. 13. Accessed at <http://search.proquest.com/docview/613555931?accountid=13042>.

- Trevithick, A., 'New Age in Indo-U.S. Ties', *The Times of India*, 12 February 1986, p. 8.
- Trumbull, R., 'Bands Organize Massacres in India: Religious Fanaticism and Poverty Behind Use of Terror', *The New York Times*, 14 September 1947, E5.
- Trumbull, R., 'India Faces Crisis on 4th Birthday', *The New York Times*, 16 August 1951, p. 3.
- Tucker, A., 'Drugs Today', *Guardian*, 26 January 1965, p. 10.
- Tyabji, N., 'Gaining Technical Know-How in an Unequal World: Penicillin Manufacture in Nehru's India', *Technology and Culture*, 45(2) (2004), pp. 331–49.
- UNFPA. Accessed 25 July 2014 at <http://unfpa.org/public/home/about>.
- UNFPA – India. Accessed 25 July 2014 at <https://data.unfpa.org/docs/ind> on.
- Unger, C.R., 'Towards Global Equilibrium: American Foundations and Indian Modernization, 1950s to 1970s', *Journal of Global History*, 6(1) (2011), pp. 121–42.
- Universiti Teknologi Malaysia. Accessed at [www.cheme.utm.my/cheme/index.php/global-outreach-programme/2010/bioprocess-student-society-india-trip-2010](http://www.cheme.utm.my/cheme/index.php/global-outreach-programme/2010/bioprocess-student-society-india-trip-2010).
- US National Library of Medicine, Alan Gregg Papers. Accessed at <http://profiles.nlm.nih.gov/ps/retrieve/Narrative/FS/p-nid/212>.
- 'U.S.-Based Indian Doctors to Transfer Technology', *The Times of India*, 4 March 1985, p. 8.
- 'U.S. Exports to India: 1945 Purchases Total \$69,500,000', *The Times of India*, 12 July 1946, p. 4.
- Vakil, C.N., *Economic Consequences of Divided India* (Bombay, 1950).
- Varshney, A., *Ethnic Conflict and Civic Life: Hindus and Muslims in India* (New Haven, 2003).
- Vashishtha, V.M., and Kumar, P., 'Fifty Years of Immunization in India: Progress and Future', *Indian Pediatrics*, 50(1), (2013), pp. 111-118.

- Venkatchaliah, M.N., 'Globalised Discontent: Outsourcing Can Help Bridge Rich-Poor Divide', *The Times of India*, 7 April 2004, p. 12.
- Vicziany, M., 'Coercion in a Soft State: The Family-Planning Program of India: Part 2: The Sources of Coercion', *Pacific Affairs* (1982), pp. 557–92.
- 'Vijay Merchant Not Going to Australia; Ill-Health Compels India's Skipper To Relinquish Post,' *The Times of India*, 14 August 1947, p 1.
- Virdee, P., 'Negotiating the Past: Journey through Muslim Women's Experience of Partition and Resettlement in Pakistan', *Cultural and Social History*, 6(4) (2009), pp. 467–83.
- Visalakshi, S. and Sandhya, G.D., 'R&D in Pharma Industry in Context of Biotech Commercialisation', *Economic and Political Weekly*, 35(48) (2000), p. 4223-4233.
- Viswanathan, A., 'Special 301: Behind the US threat', *The Times of India*, 20 June 1991, p. 10.
- Wadhwa, V., Rissing, B.A., Gereffi, G., Trumbour, J., and Engardio, P., 'The Globalization of Innovation: Pharmaceuticals: Can India and China Cure the Global Pharmaceutical Market', Kauffman: The Foundation of Entrepreneurship (June 2008), p. 31. Accessed 5 September 2014 at [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1143472](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1143472).
- 'Wall St. Focuses on the Drug Field', *The New York Times*, 3 April 1960, p. 9.
- Ward, B., 'India in the Strategy of Western Aid', *Guardian*, 15 August 1961, p. 10.
- Wellcome Trust, Funding. Accessed 11 August 2014 at [www.wellcome.ac.uk/Funding/Innovations/Funded-projects/India/index.htm](http://www.wellcome.ac.uk/Funding/Innovations/Funded-projects/India/index.htm).
- Whitfield, S.J., *The Culture of the Cold War* (Baltimore, 1991).
- P. Wolcott and S.E. Goodman, 'Global Diffusion of the Internet-I: India: Is the Elephant Learning to Dance?', *Communications of the Association for Information Systems*, 11(1) (2003), pp. 560–646.

Wolpert, S.A., *A New History of India* (Oxford, 1997).

Wolpert, S.A., *Gandhi's Passion: The Life and Legacy of Mahatma Gandhi* (Oxford, 2001).

Worboys, M., 'The Colonial World as Mission and Mandate: Leprosy and Empire, 1900–1940', *Osiris*, (2000), pp. 207–18.

Yahya, F., 'India and Southeast Asia: Revisited', *Contemporary Southeast Asia*, 25(1) (2003), pp. 79–103.

Zachariah, B., *Nehru* (London and New York, 2004).

Zinkin, T., 'India's New Violence: After a Social Eruption', *Manchester Guardian*, 25 July 1956, p. 6.

### **Unpublished Theses**

Conley, J.M., 'Indo-Russian military and nuclear cooperation: implications for US security interests', (USAF Institute for National Security Studies PhD thesis, 1999).

Engh, S., 'Population Control in the 20th Century: Scandinavian Aid to the Indian Family Planning Programme' (University of Oxford, D.Phil thesis, 2005).

Ireland, D., 'India's Competition Regimes and Informal Business Institutions: Interaction, Conflict and Accommodation' (Carleton University, D.Phil thesis, 2008).

### **Interviews**

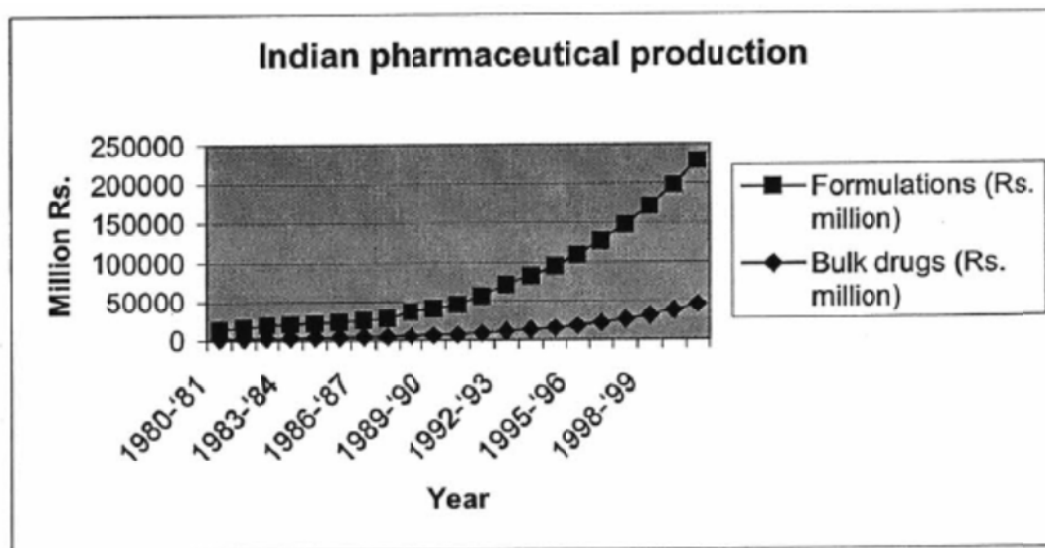
Interview D.A. Henderson 9 October 2013.

Interview Dr. Richard Bakalar 22 January 2010.

## Statistical Appendix

What follows is a series of tables that portray the scope of the demand for medical technology in India from 1947 to 1991, as well as links between the demand and supply sides of the medical technology industry.

Table 1.1



Source: WIPO, 2002

Srinivas, S. (2004). *Technological Learning and the Evolution of the Indian Pharmaceutical and Biopharmaceutical Sectors* (Doctoral dissertation, Massachusetts Institute of Technology), p. 80.

Table 1.1 shows the rapid growth in production of pharmaceuticals following the initial liberalization of India's economy in the mid-1980s and the wider liberalization of its economy in the 1990s. Such production statistics indicate attempts at meeting an dramatically increased demand for pharmaceuticals.

Table 1.2

Sub-sectors	1951-56 Plan I	1956-61 Plan II	1961-66 Plan III	1966-69 Annual	1969-74 Plan IV	1974-79 Plan V	1980-85 Plan VI	1985-90 Plan VII	1992-97 Plan VIII
Control of communicable diseases	231.0 (16.5)	640.0 (28.4)	690.0 (27.7)	231.0 (10.2)	1270.0 (11.1)	2681.7 (11.5)	5240.0 (27.0)	10126.7 (7.7)	10450.0 (4.2)
Total health	903.0 (64.5)	1460.0 (64.9)	1500.0 (60.2)	939.0 (41.6)	4335.0 (37.5)	7962.0 (34.1)	18211.0 (27.0)	33928.9 (25.8)	75759.5 (30.5)
Family planning	7.0 (0.5)	30.0 (1.3)	270.0 (10.8)	829.0 (36.7)	3150.0 (27.3)	5160.0 (22.1)	10100.0 (15.0)	32562.0 (24.7)	65000.0 (26.0)
Water supply and sanitation	490.0 (35.0)	760.0 (35.3)	720.0 (28.9)	490.0 (21.7)	4070.0 (35.2)	10220.0 (43.8)	39220.0 (58.0)	55970.0 (50.5)	107430.3 (43.0)
Grand total of health + family welfare + water supply and sanitation	1400.0	2250.0	2490.0	2258.0	11555.0	23342.0	57530.0	131716.5	248189.8

Figures in parentheses are percentages of grand total, except for communicable diseases, which is per cent of total health. Source: respective Five Year Plans of the Government of India, Planning Commission.

'Intrasectoral financial allocations for health sector (millions of rupees)'. Reprinted from Imrana Qadeer, "Health care systems in transition III. India, Part I. The Indian Experience", *Journal of Public Health Medicine*, Vol. 22, No.1 (2000), pp. 25-32.

Table 1.2.: The demand for public health services, specifically medical technology, can clearly be seen during the period 1947-91. Government funding for technologies for controlling communicable diseases rose roughly 2,000% between 1951 and 1997. Similarly, funding for family planning rose nearly 1,000%.

Table 1.3

## Revenue Expenditure on Health: Union Government and States

Year	1950-51	1960-61	1970-71	1980-81	1985-86	1990-91	1994-95	1999-00	2000-01
<b>A: Amount in Rupees Million</b>									
<b>Major States</b>									
Union Govt.	19.97	267.8	284.35	1022.18	2561.31	5523.53	8109.19	17219.15	25064.76
Andhra Pradesh	—	75.57	259.39	876.22	1837.5	3268.04	5601.91	10940.18	12860.91
Assam	6.29	30.42	74.93	232.6	647.08	1103.1	1921.47	3070.24	3461.82
Bihar	16.47	65.27	152.53	544.11	1235.19	2713.33	4128.06	10162	9964.3
Gujarat	—	31.88	213.87	641.99	1480.19	2510.76	4131.96	9131.27	8937.52
Haryana	—	—	75.58	238.17	597.82	819.28	1427.65	2839.31	2909.09
Jammu Kashmir	—	10.4	46.29	196.74	420.23	756.28	1569.14	3352.51	3610.48
Karnataka	0.46	46.36	159.53	603.49	1385.49	2430.15	4577.49	8682.94	9035.63
Kerala	—	44.49	150.11	570.92	1133.97	2127.69	3432.39	6880.37	6738.91
Madhya Pradesh	7.01	55.62	197.04	687.85	1500.99	2745.52	4473.32	8365.2	8319.9
Maharashtra	4.59	90.68	385.33	1252.05	2694.19	4774.24	7580.35	13547.7	15953.42
Orissa	6.97	25.9	107.59	408.74	739.01	1350.29	2187.21	4256.7	4331.06
Punjab	7.83	42.11	98.31	387.11	842.18	1662.89	2261.66	5445.62	6375.88
Rajasthan	—	44.98	212.21	569.01	1225.12	2506.66	4608.69	8580.3	8775.99
Tamil Nadu	41.89	83.12	278.5	882.32	1885.12	3790.06	6100.09	11414.77	11604.94
Uttar Pradesh	30.02	74.01	281.12	1116.18	3712.17	6214.3	8981.31	12702	14102.2
West Bengal	37.17	88.18	256.91	1096.08	2015.13	4330.13	5262.32	12274.95	13766.15
<b>Other States</b>									
Arunachal Pradesh	—	—	—	42.07	82.91	170.62	280.94	539.6	536.1
Goa, Daman and Diu	—	—	19.51	53.58	118.87	238.38	362.76	765.88	823.64
Mizoram	—	—	—	37.9	89.3	149.18	257.83	536.9	538.5
Pondicherry	—	—	10.95	35.02	83.61	181.88	281.42	731.51	804.16
Himachal Pradesh	—	—	39.88	154.63	324.4	667.33	1163.7	2478.2	2630.6
Manipur	—	—	10.89	53.63	95.9	188.2	284.13	753.4	663.7
Meghalaya	—	—	10.65	66.56	124.93	207.62	304.18	636.8	705.1
Nagaland	—	—	17.82	55.92	158.73	245.92	323.41	626.3	764.36
Sikkim	—	—	—	12.79	37.47	79.31	144.1	336.51	317.3
Tripura	—	—	13.79	44.19	122.1	277.09	358.31	711.3	827.34
Delhi	—	—	—	—	—	—	1573.51	3913.6	4392.4
Chattisgarh	—	—	—	—	—	—	—	—	771.2
Jharkhand	—	—	—	—	—	—	—	—	—
Uttaranchal	—	—	—	—	—	—	—	—	342.2
All India	218.55	1076.82	3351.18	11888.12	27153.91	51031.68	81738.5	150733.21	178189.04
<b>B: As Percentage of Total Government Revenue Expenditure</b>									
<b>Major States</b>									
Union Govt.	0.47	2.53	0.58	0.48	0.52	0.54	0.46	0.5	0.75
Andhra Pradesh	—	8.89	8.74	7.55	6.61	5.94	5.89	6.06	5.57
Assam	6.74	7.51	6.2	6.51	6.75	5.81	5.87	5.25	5.39
Bihar	6.32	9.02	6.53	5.72	5.61	5.48	5.46	6.3	6.95
Gujarat	—	6.22	9.75	7.11	7.51	5.8	5.48	5.21	4.05
Haryana	—	—	3.09	5.94	7	4.24	*	4.08	4.05
Jammu Kashmir	—	8.58	6.68	7.35	7.61	6.06	6.21	5.54	5.45
Karnataka	0.35	5.83	6.32	6.74	6.6	6.12	6.3	5.7	5.42
Kerala	—	9.67	9.16	8.55	7.81	7.53	6.77	5.95	5.67
Madhya Pradesh	2.48	8.42	9.66	6.77	6.65	5.78	5.73	5.18	5.55
Maharashtra	6.22	7.6	3.38	6.53	5.97	5.45	5.12	4.59	4.27
Orissa	5.8	7.29	7.69	7.47	7.31	5.4	5.35	5.03	4.9
Punjab	3.8	7.12	7.22	7.04	7.24	5.54	3.74	5.34	5.44
Rajasthan	—	9.89	9.64	8.28	8.11	7.2	6.83	6.39	5.84
Tamil Nadu	7.05	9.12	8.66	7.66	7.7	6.72	6.33	5.51	5.34
Uttar Pradesh	5.79	5.13	6.79	6.5	9.75	6.52	5.83	4.42	4.54
West Bengal	9.89	9.48	8.8	9.83	8.92	8.44	6.9	6.3	6.23
<b>Other States</b>									
Arunachal Pradesh	—	—	—	6.86	5.85	6.61	6.41	6.57	5.9
Goa, Daman and Diu	—	—	15.01	10.29	8.22	8.65	7.6	5.33	4.82
Mizoram	—	—	—	7.03	6.8	4.91	5.56	6	5.27
Pondicherry	—	—	13.96	10.6	9.11	8.91	7.84	8.65	8.75
Himachal Pradesh	—	—	6.39	8.24	7.89	7.4	7.21	6.48	6.01
Manipur	—	—	7.17	7.68	6.15	5.6	5.59	5.55	5.87
Meghalaya	—	—	11.04	11.12	9.2	6.68	6.66	6.11	6.53
Nagaland	—	—	7.24	6.11	6.96	5.85	5.53	5.31	5.92
Sikkim	—	—	—	4.17	4.83	6.19	2.74	2.23	4.16
Tripura	—	—	7.91	5.07	6.53	5.57	*	4.87	4.77
Delhi	—	—	—	—	—	—	—	11.11	11.88
Chattisgarh	—	—	—	—	—	—	—	—	4.78
Jharkhand	—	—	—	—	—	—	—	—	—
Uttaranchal	—	—	—	—	—	—	—	—	3.75
All India	2.69	5.13	3.84	3.29	3.29	3.02	2.67	2.97	3.13

Notes: — = No; applicable; \* = Not available.

Source: Up to 1985-86 is combined finance and revenue accounts comptroller and auditor general of India GOI, respective years, Other years - Finance Accounts, respective states, respective years; RBI, Finances of the State Governments, respective years.

Table 1.3 is drawn from a review of healthcare in India undertaken in 2005. It shows the rapid growth of health care expenditures on both state and federal levels from 1950 to 2000. These numbers show a dramatic rise in health care expenditure in India during the period of this thesis. Such expenditure was overwhelmingly directed toward medical technologies, which in turn spurred further growth within the industry.

Table 1.4

**Pattern of Investment and Expenditures on Health and Family Welfare  
(Rs. Billions) and selected Health Outcomes**

Plan Period	Public Health Investment and Expenditures						Private Health		Total Health		Health Outcomes	
	Health & FW Plan & FW Expd.	Health & FW as percent of Plan	Health & FW Expenditure - non plan + Govt Expd.	Percent Health & FW of Total	Percent Health & FW of GDP	Percent Plan H& FW Expd.	Private Health Expenditure	Private Health as % of GDP	Total Health Expenditure	Public as % of Total Health	IMR at end of plan period	Life Expectancy during plan period
First Plan (Actuals) (1951-56)	0.65	3.33	2.27	3.74	0.44	28.63	7.5	1.46	9.77	23.2	148	37
Second Plan (Actuals) (1956-61)	1.46	3.12	3.93	3.52	0.56	37.15	13.2	1.88	17.13	22.9	138	44
Third Plan (Actuals) (1961-66)	2.51	2.92	6.68	2.65	0.62	37.57	26.89	2.53	33.57	19.9		
Annual Plans (Actuals) (1966-69)	2.11	3.18	6.84	2.8	0.69	30.85	26.92	2.71	33.76	20.3	129	51
Fourth Plan (Actuals) (1969-74)	6.14	3.89	19.91	3.35	0.84	30.84	67.02	2.83	86.93	22.9	129	
Fifth Plan (Actuals) (1974-79)	12.53	3.18	34.33	2.86	0.81	36.5	148.21	3.52	182.54		120	52
Annual Plan (1979-80)	3.84	3.3	11.29	3.19	1.04	34.01	45.85	4.21	57.14	19.8	114	52
Sixth Plan (Actuals) (1980-85)	34.12	3.12	95.72	3.15	1.1	35.64	354.64	4.06	450.36	21.3	96	55
Seventh Plan (Actuals) (1985-90)	68.09	3.11					556.05	3.35			80	58
Annual Plans (1990-91, 1991-92)	37.71	3.06	109.95	2.94	0.99	34.3	307.63	2.8	417.58	26.3	79	59
Eighth Plan (Actuals) (1992-97)	141.1	2.9	434.34	2.52	0.93	32.49	1352.23	2.88	1786.57	24.3	71	61
Ninth Plan (Anticipated Exp.) (1997-2002)	299.96	3.19	847.69	2.65	0.97	35.38	3054.24	3.49	3901.93	21.7	66	65
Tenth Plan (draft outlay) 2002-2007	589.2	3.86	1785*	2.5*	1*	33*	7500*	4.28*	9285*	19.2*	60*	67*

Source - For Plan data: 1. Indian Planning Experience - A Statistical Profile, Planning Commission, GOI, New Delhi, 2000; 2. Ninth Five Year Plan, Planning Commission, GOI, New Delhi, 1998; 3. Draft Tenth Five Year Plan, www.planningcommission.nic.in/ ; For Total public health expenditures (ministries of Health and FW : 1. upto 1986 - Combined Finance and Revenue Accounts, respective years, GOI, New Delhi; 2. 1987-2002 Finance Accounts of States and Union Government, respective years; and RBI - Finances of the State Governments, respective years, RBI, Mumbai; For private health expenditures & GDP data - National Accounts Statistics, CSO, 2003; For health outcomes - Registrar General of India, respective years. \*Projections estimated by author

Actual expenditures are highlighted further in Table 1.4, from the same review as Table 1.3. A direct correlation is shown between the increase in funding for health care and the near doubling of life expectancy during the same period, due to the broad implementation of medical technology, particularly in the area of communicable and infectious disease, easily preventable with relatively simple antibiotics, vaccinations and inoculations.

Table 1.5

**Profitability in the Pharmaceutical Industry**

Profitability before Tax as Percentage of Sales	Year
1969-70	15.47
1971-72	10.19
1972-73	8.53
1974-75	10.7
1975-76	10.4
1977-78	11.7
1978-79	12.0
1978-80	12.4
1980-81	8.8
1981-82	8.0
1982-83	7.5
1983-84	6.7
1984-85	5.8
1985-86	4.0

*Sources:* 1969-70 to 1973-74: Hathi Committee Report  
 1974-75 to 1980-81: RBI Bulletins  
 1981-82 to 1983-84: NCAER Study  
 1984-85: A. F. Ferguson Survey  
 1985-86: OPPI estimates

Sahu, S. K. *Globalization and the Indian Pharmaceutical Industry*, (2014), p. 15.

Table 1.5 highlights the profitability of the pharmaceutical industry from 1969 to 1977. It shows data critical to understanding the economic situation of the pharmaceutical industry. Although the table depicts a nearly 80% drop in profitability during this period, such statistics are

misleading. Whilst those profits were shrinking, the government was massively expanding coverage among the Indian population. What was lost in profit margin was made up for in volume. This is important to remember as one observes demand for medical technology following the Patents Act, as it rose to unprecedented levels.

Table 1.6

Combinations	State and measure											
	Karnataka			Maharashtra			Tamil Nadu			West Bengal		
	% of PHCs	Avg. no. of sterilizations	Avg. no. of IUD insertions	% of PHCs	Avg. no. of sterilizations	Avg. no. of IUD insertions	% of PHCs	Avg. no. of sterilizations	Avg. no. of IUD insertions	% of PHCs	Avg. no. of sterilizations	Avg. no. of IUD insertions
At least one trained MD, at least one MD staying in PHC area, adequate paramedics, an operating theater, and a working vehicle	37	9.35	4.65	40	12.20	12.24	29	6.10	2.42	19	5.42	1.07
At least one trained MD, adequate paramedics, an operating theater, and a working vehicle	37	9.33	4.62	45	11.76	11.72	30	6.09	2.41	20	5.51	1.05
At least one trained MD, an operating theater, and a working vehicle	47	9.31	4.58	48	11.69	11.73	32	6.19	2.34	26	5.71	1.12
At least one trained MD and a working vehicle	59	9.33	4.66	67	10.58	10.77	37	6.01	2.33	41	5.68	1.17
At least one trained MD and an operating theater	50	9.40	4.60	52	11.82	11.93	33	6.12	2.32	47	5.50	1.18
At least one trained MD, but no operating theater	14	na	na	23	na	na	5	na	na	27	na	na
No trained MD, but an operating theater	16	na	na	10	na	na	52	na	na	11	na	na

Tables depict "...data on family planning performance of the PHCs were obtained for fiscal years 1984-1985, 1985-1986 and 1986-1987. Average number of sterilizations and IUD insertions reflected are per 1,000 population per year from April 1, 1984, to March 31, 1987, in a PHC area." Reprinted from K. Srinivasan, P. C. Saxena, T. K. Roy and R. K. Verma, 'Effect of Family Planning Program, Components on Contraceptive Acceptance in Four Indian States', *International Family Planning Perspectives*, Vol. 17, No. 1 (Mar., 1991), pp. 14-24.

Table 1.6 indicates a level of medical technological diffusion previously unknown at the primary health centres across rural states such as Karnataka and Maharashtra. The table shows the diffusion of family planning technologies and their usage at the primary clinics, and the average

number of sterilisations and IUD insertions at these clinics. Nearly one third to one half of all primary health centres in these states offered both sterilisations and IUDs, showing a demand for family planning technology that would have been unimaginable at the time of independence.

Table 1.7: Mean value of program input and performance, by component, according to state and level of socioeconomic development among PHCs.

Program input and performance components	State and socioeconomic level															
	Karnataka				Maharashtra				Tamil Nadu				West Bengal			
	All	High	Med.	Low	All	High	Med.	Low	All	High	Med.	Low	All	High	Med.	Low
<b>Program Input</b>																
No. of MDs per 100,000 in PHC area	3.09	3.06	3.09	3.10	6.52	7.02	6.40	5.73	2.78	2.91	3.06	2.40	3.78	4.13	3.72	3.72
No. of paramedics per 100,000 in PHC area	28.2	34.2	28.3	25.1	33.7	36.2	31.2	32.5	25.3	28.6	23.2	25.8	23.6	24.1	23.6	23.1
PHC has at least one MD trained in laparoscopy or tubectomy	0.64	0.60	0.66	0.64	0.75	0.72	0.77	0.78	0.38	0.36	0.31	0.47	0.74	0.69	0.76	0.74
No. of trained dais per 100,000 in PHC area	0.79	0.89	0.84	0.70	0.91	0.98	0.84	0.90	0.90	0.83	0.89	0.94	0.80	0.85	0.72	0.89
At least one MD stays in staff quarters or PHC area	0.89	0.91	0.87	0.89	0.78	0.75	0.80	0.79	0.96	0.96	0.97	0.95	0.95	0.97	0.96	0.92
PHC has operating theater	0.65	0.72	0.66	0.60	0.59	0.56	0.56	0.69	0.85	0.78	0.88	0.84	0.59	0.46	0.56	0.71
PHC has at least one working vehicle	0.88	0.87	0.85	0.92	0.88	0.87	0.87	0.92	0.98	0.99	0.97	0.99	0.56	0.67	0.53	0.54
PHC has adequate medical facilities	0.69	0.76	0.71	0.65	0.21	0.23	0.21	0.20	0.54	0.49	0.56	0.56	0.41	0.49	0.37	0.44
PHC has adequate service facilities	0.77	0.80	0.79	0.73	0.61	0.63	0.57	0.63	0.92	0.95	0.91	0.92	0.33	0.26	0.30	0.42
PHC offers additional incentives	0.57	0.65	0.54	0.57	0.51	0.52	0.51	0.50	0.24	0.18	0.18	0.36	0.06	0.08	0.06	0.04
<b>Program Performance</b>																
Avg. annual no. of sterilizations per 1,000 population in PHC	9.20	8.80	9.33	9.28	9.92	10.46	9.92	8.88	6.02	6.41	5.13	6.83	5.34	5.70	5.27	5.26
Avg. annual no. of IUD Insertions per 1,000 population in PHC	4.65	5.01	4.68	4.43	10.05	9.55	9.87	11.31	2.53	3.56	2.44	2.05	1.15	1.18	1.10	1.23

Reprinted from K. Srinivasan, P. C. Saxena, T. K. Roy and R. K. Verma, 'Effect of Family Planning Program, Components on Contraceptive Acceptance in Four Indian States', *International Family Planning Perspectives*, Vol. 17, No. 1 (Mar., 1991), pp. 14-24.

Table 1.7 indicates the demand for medical technology in specialized areas. Technologies such as operating theatres and laparoscopy equipment were novel at this point in time. This table is notable in that it juxtaposes demand for medical technologies with the paucity of medical

personnel and operating theatres. Measured at rates per 100,000 or per 1,000, Table 1.7 shows that family planning intervention, in the form of either sterilisations or IUD insertions, varied based upon socioeconomic status. However, it shows that demand for these technologies was high regardless of whether there was a trained physician or an operating theatre available at the primary healthcare centre. Furthermore, this table illustrates the importance of simple, transportable medical technologies that could easily be utilized by clinical staff with even the most rudimentary training. This demonstrates high demand among women for control over their reproductive rights and opportunity to integrate into the national economy outside of the domestic sphere.

Table 1.8

<b>APPROACHED BY INDIAN FIRMS FOR TECHNOLOGY PURCHASE</b>	
<b>No of Firms Approached</b>	<b>No of Collabo- rations</b>
<b>One firm</b>	<b>28 ( 30)</b>
<b>Two-three firms</b>	<b>31 ( 34)</b>
<b>More than three firms</b>	<b>33 ( 36)</b>
<b>Total</b>	<b>92 (100)</b>

**Note: Figures in parenthesis are in per cent.**

‘Number of {foreign} suppliers approached by Indian firms for technology purchase’. Reprinted from Ghayur Alam, ‘India's Technology Policy and Its Influence on Technology Imports and Technology Development’, *Economic and Political Weekly*, Vol. 20, No. 45/47 (1985), pp. 2073 -2077, 2079-2080.

Table 1.8 indicates the number of foreign firms approached by Indian firms for technology purchase, and shows how domestic demand spurred significant engagement of foreign firms for technological transfer.

Table 1.9

Therapeutic segment	Share of retail sales (%)			
	World: 2001		India: 2000	
	Rank	Share(%)	Rank	Share(%)
Cardiovascular system	1	19	4	8
Central nervous system (CNS)	2	16	6	6
Alimentary tract and metabolism	3	15	1	23.6
Respiratory system	4	9	3	10
Anti-infectives	5	9	2	23
Musculo-skeletal	6	6	5	7
Genito-urinary	7	5	9	3
Cytostatics and immunosuppressants	8	4	13	0
Dermatologicals	9	3	7	5
Blood and blood-forming agents	10	3	8	3
Sensory organs	11	2	10	1.6
Diagnostic agents	12	1	12	0.1
Systemic hormonal products	13	1	11	1.5
Others including parasitology		2.3		5

Source: World sales shares from IMS World Drug Purchases—Retail Pharmacies, IMS Drug

Monitor, 2001. Indian domestic sales shares based on authors' calculations from ORG-MARG retail pharmaceutical audit.

Table 1.9 comes from the WHO IMS World Drug Purchase Report in 2000, and shows substantial differences in demand for pharmaceuticals in India compared to the rest of the world. The most interesting aspect is the anti-infective category: anti-infectives are the second-most important type of pharmaceutical in India, accounting for 23% of pharmaceuticals sold in India, whereas they are only the fifth-most important worldwide, accounting for only 9% of the total share. These statistics highlight variations in pharmaceutical usage in developing and developed nations.

Table 1.10

<i>Round</i>	<i>Initial tuberculin testing</i>	<i>X-ray examinations</i>	<i>Mean observation period (years)</i>
I	Nov. 1950- Aug. 1951	Sept. 1950- Nov. 1951	6.9
II	Oct. 1951- Dec. 1952	Nov. 1951- Feb. 1953	5.3
III	Jan. 1953- March 1954	Aug. 1953- July 1954	4.3
IV	April 1954- Jan. 1955	July 1954- Feb. 1955	3.3
V	Feb. 1955- Sept. 1955	June 1955- Sept. 1955	2.4
VI	(not done)	April 1957- June 1958	—

Reprinted from J. Frimodt-Moller, J. Thomas, R. Parthasarathy, 'Observations on the Protective Effect of BCG Vaccination in a South Indian Rural Population' (1964).

Table 1.10 shows the implementation of tuberculosis technologies. The mean observations of tuberculosis infections dropped nearly 60% from 1951 to 1958. This drop in the incidence rate of tuberculosis shows not only an increase in demand for drugs to treat tuberculosis, but also an increase in the usage of X-ray machines to begin population-wide screening for the infection itself. The demand for these technologies is documented in the sections of this thesis concerning procurement of technology from Germany and the United States, notably the case study of the Rockefeller Foundation and the All India Institute.

Table 1.11

1.2: Infant Mortality Rates: All India (per 1000 live births)

State/Year	1981			1986			1991		
	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
Andaman & Nicobar	NA	NA	NA	NA	NA	NA	30.0	31.5	23.0
Andhra Pradesh	86.0	93.0	52.0	82.0	87.5	59.0	73.0	77.0	56.0
Arunachal Pradesh	NA	NA	NA	NA	NA	NA	64.5	67.1	27.2
Assam	106.0	107.0	76.0	109.0	111.0	69.0	81.0	83.0	42.0
Bihar	118.0	124.0	60.0	101.0	104.0	68.0	69.0	71.0	46.0
Chandigarh	NA	NA	NA	NA	NA	NA	35.3	32.2	35.7
Chattisgarh	-	-	-	-	-	-	-	-	-
Dadra & Nagar Haveli	NA	NA	NA	NA	NA	NA	68.0	68.0	0
Delhi	NA	NA	NA	NA	NA	NA	42.7	69.4	39.8
Goa, Daman & Diu	NA	NA	NA	NA	NA	NA	20.8	25.4	11.7
Gujarat	116.0	123.0	89.0	107.0	124.0	66.0	69.0	73.0	57.0
Haryana	101.0	108.0	52.0	85.0	91.0	58.0	68.0	73.0	49.0
Himachal Pradesh	71.5	71.7	64.5	87.9	90.1	41.1	74.6	76.4	38.2
Jammu & Kashmir	71.5	75.9	41.1	81.5	86.0	58.1	NA	NA	NA
Jharkhand	-	-	-	-	-	-	-	-	-
Karnataka	69.0	77.0	45.0	73.0	82.0	47.0	77.0	87.0	47.0
Kerala	37.0	40.0	24.0	27.0	28.0	20.0	16.0	17.0	16.0
Lakshadweep(I)	NA	NA	NA	NA	NA	NA	43.8	66.7	11.9
Madhya Pradesh	142.0	152.0	80.0	118.0	124.0	82.0	117.0	125.0	74.0
Maharashtra	79.0	90.0	49.0	63.0	73.0	44.0	60.0	69.0	38.0
Manipur	NA	NA	NA	NA	NA	NA	21.7	22.1	20.0
Meghalaya	NA	NA	NA	NA	NA	NA	57.0	61.5	18.3
Mizoram	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nagaland	NA	NA	NA	NA	NA	NA	6.6	7.4	0
Orissa	135.0	140.0	68.0	123.0	127.0	75.0	124.0	129.0	71.0
Pondicherry	NA	NA	NA	NA	NA	NA	21.2	21.8	20.7
Punjab	81.0	88.0	51.0	68.0	72.0	55.0	53.0	58.0	40.0
Rajasthan	108.0	118.0	53.0	107.0	113.0	71.0	79.0	84.0	50.0
Sikkim	NA	NA	NA	NA	NA	NA	51.0	53.8	29.5
Tamil Nadu	91.0	103.7	55.3	80.0	92.6	54.0	57.0	65.0	42.0
Tripura	NA	NA	NA	NA	NA	NA	56.2	56.9	45.7
Uttar Pradesh	150.0	157.0	97.0	132.0	140.0	88.0	97.0	102.0	74.0
Uttaranchal	-	-	-	-	-	-	-	-	-
West Bengal	91.0	98.0	44.0	71.0	75.0	55.0	71.0	76.0	47.0
All India	110.4	119.1	62.5	96.4	104.6	62.0	80.0	87.0	53.0

Sources: Health Information of India, CBHI, GOI, respective years

Note: NA - not available; Data for Chattisgarh, Jharkhand, Uttaranchal are included in their parent state

Review of Healthcare in India (Mumbai: Centre for Enquiry into Health and Allied Themes, 2005), p. 336.

Table 1.11 addresses infant mortality, defined as the death of children ages 0-5. Much of the infant mortality rate in developing nations stem from easily treated conditions that lead to diarrhoea and dehydration. These include viruses such as malaria, dengue, and measles. When properly vaccinated or treated with relatively inexpensive medicines, children's lives can be saved. Table 1.11 shows a significant decline in infant mortality rates per thousand live births in 1981, 1986, and 1991. The production, distribution, and proper implementation of these medical technologies, driven by a demand among the Indian population for Western medicines, were largely responsible for the drop in infant mortality rates during this period.

Table 1.12

Contraceptive decision	Trimester				Total	
	First		Second			
	N	%	N	%	N	%
Total sample	1,115	100.0	826	100.0	1,941	100.0
Contraception accepted						
No	100	9.0	130	15.7	230	11.8
Yes	1,015	91.0	696	84.3	1,711	88.2
Method chosen						
Sterilization	466	41.8	580	70.2	1,046	53.9
IUD	484	43.4	95	11.5	579	29.8
Oral contraception	58	5.2	18	2.2	76	3.9
Condom	7	0.6	3	0.4	10	0.5

‘Contraceptive method chosen by married women at time of medical termination of pregnancy, by trimester, Mahatma Gandhi Institute of Medical Sciences, Sevagram, India, 1976-87’. Reprinted from S. Chhabra, N. Gupte,

A. Mehta and A. Shende, 'Medical termination of Pregnancy and Concurrent Contraceptive Adoption in Rural India', *Studies in Family Planning*, Vol. 19, No. 4 (1988), pp. 244-247.

Table 1.12: The use of contraceptive technologies, whether sterilisation, IUD, oral contraception, or condoms, rose during the end of the 1970s and achieved widespread use in the 1980s. This table indicates the growth rates for these family planning technologies in the first and second trimesters of pregnancy.

Table 1.13

State	Rural population as a % of total population	Sterilizations	IUCD insertions
1. Andhra Pradesh	82.6%	52.5%	47.8%
2. Bihar	91.6	17.0	64.1
3. Gujarat	74.2	39.1	60.0
4. Haryana	82.8	62.3	58.8
5. Jammu & Kashmir	83.3	78.7	80.6
6. Kerala	84.9	—	80.1
7. Mysore	77.7	84.7	74.9
8. Maharashtra	71.8	61.4	63.1
9. Orissa	93.7	78.2	65.8
10. Punjab	76.9	62.6	65.7
11. Uttar Pradesh	87.1	87.0	62.9
12. West Bengal	75.5	65.8	60.5
13. Rajasthan	83.7	59.0	51.4
All the above States	82.3	58.9	62.7

'Percentage of rural to total population'. Reprinted from Shri Govind Narain, 'The Family Planning Program Since 1965', *Studies in Family Planning*, Vol. 1, No. 35 (1968), pp. 1-12.

Table 1.13 shows the percentage of the rural population using various technological methods for family planning. The use of family planning tools was not just an urban, industrialised phenomenon, but one that was also diffused across the rural parts of India. The growth of medical technology in rural India can largely be attributed to the fact that these technologies

were not only cheap but also easily transported. Though not uniform, the medical technology complex touched all segments of Indian society.

Table 1.14

Year	No. of Sterilizations		No. of IUCD insertions	
	During the period	Cumulative total	During the period	Cumulative total
1956 to March 1965	983,064	983,064	—	—
1965-66	542,779	1,525,843	812,713	812,713
1966-67	887,368	2,413,211	909,726	1,722,439
1967-68	1,839,840	4,248,570	668,979	2,388,592
April-July 1968 (incomplete)	360,709	4,613,760	131,978	2,523,396

‘Number of sterilization operations and IUCD insertions done’. Reprinted from Shri Govind Narain, ‘The Family Planning Program Since 1965’, *Studies in Family Planning*, Vol. 1, No. 35 (1968), pp. 1-12.

Table 1.14 indicates the growth of IUD insertions from 1956 to 1968. The cumulative growth during that decade was over 400%, indicating strong demand for family planning technologies.

Table 1.15

year	sterilization		I.U.C.D.		conventional contraceptives	
	number of sterilization	rate per thousand of population	number of IUCD insertions	rate per thousand of population	number of conventional contraceptive users	rate per thousand of population
1966-67	887368	1.83	909726	1.87	464605	0.96
1967-68	1893811	3.81	668979	1.35	475236	0.96
1968-69	1664064	3.27	478731	0.94	960896	1.89
1969-70	1422118	2.73	459726	0.88	1515329	2.91
1970-71	1319120	2.47	471048	0.88	2097824	3.93
1971-72	2138172	3.91	462968	0.85	2234462	4.08

Source: Ministry of Health and Family Planning: *Progress of Family Planning Programme in India, 1972.*

‘Progress of the Family Planning Programme in India during 1966-72’. Reprinted from O.P. Vig and B.B. Yeole, ‘Reduction in Birth Rate Due to Various Combinations of Sterilization, I.U.C.D. and Contraceptive Programme in India through Use of Birth Order Statistics’, *The Indian Journal of Statistics*, Series B, Vol. 37, No. 1 (Feb., 1975), pp. 121-134.

Table 1.15 shows the continued demand for IUCDs and conventional contraceptive technologies from the 1960s to the early 1970s. The table shows the rapidly increasing rate of sterilization technologies and conventional contraceptive technologies, and the decline of IUCD technology. Whilst demand for most technologies was rising, this was not the case across the board. It was clear that there was an optimal technology usage that was part of the evolution of the MTC and its usage by patients in India.

Table 1.16: 'Number of IUD acceptors, in thousands, selected countries and regions, to December 1966'.

Region Country	Cumulative at end of		Annual			
	1965	1966	1963	1964	1965	1966
<b>ASIA<sup>1</sup></b>		3,000				
Hong Kong	40	53				13
India	318	1,250 <sup>1</sup>				932
Indonesia <sup>1</sup>		5				
Korea	345	737	1	111	233	392
Pakistan	48	532			38 <sup>2</sup>	483
Philippines <sup>1</sup>		10				10
Singapore		19				
Taiwan	150	260	4	47	99	111
Thailand	23 <sup>1</sup>	52 <sup>1</sup>		1	22	29
<b>MIDDLE EAST &amp; NORTH AFRICA<sup>1</sup></b>		100				81
Morocco <sup>1</sup>		7				7
Tunisia	14	29		1	13	14
Turkey <sup>1</sup>		30				30
U.A.R. <sup>1</sup>		35				30
<b>LATIN AMERICA<sup>1</sup></b>		155				
Barbados		4				
Chile		75				
Colombia		8				8
Peru		8				
Elsewhere		60				

<sup>1</sup> Number is an estimated order of magnitude.

<sup>2</sup> For period September through December, inclusive; 10,527 are reported prior to September 1965, but we do not have information as to how many of those were inserted during 1965.

Reprinted from P. Mauldin, D. Nortman and F. F. Stephen, 'Retention of IUDs: An International Comparison', *Studies in Family Planning*, Vol. 1, No. 18 (Apr., 1967), pp. 1-12.

Table 1.16 shows the number of IUD acceptors per thousand in several developing countries around the world from 1965-66. The growth rate in India of nearly 400% surpasses all other countries except Pakistan. The demand for IUDs and other family planning tools was significant both in terms of size and growth rate.

Table 1.17

TABLE 4. Cumulative Retention Rates per 100 IUD Acceptors, Various Programs, With and Without Reinsertions, N Months after First Insertion.

Program	With Reinsertions							Without Reinsertions						
	6	12	18	24	36	48	60	6	12	18	24	36	48	60
BARBADOS														
Nurse-midwife Insertions	82.2	76.0	70.1 <sup>2</sup>											
Physician Insertions	87.3	75.3	71.7											
CHILE: Nylon (Zipper) Ring														
	89.8	84.4	80.7	77.3	71.9	67.7	63.5	79.1	73.3	69.1	64.5	57.3	52.2	
FIJI: Loop D: 31 mm														
		86.1		76.6					75.5		64.3			
INDIA (Delhi)														
Clinic Program	91.5	85.4	79.3	73.3										
Field Program	87.0	78.0	68.7	59.6										
KOREA														
National Program <sup>1</sup>		70.9		56.1	44.1				62.4		43.7	31.0 <sup>4</sup>		
Sungdong Gu Area								70.5	58.8	52.9				
PAKISTAN														
National Research Institute <sup>1</sup>	86.1	78.6	70.0	61.2				81.1	71.3	60.8	50.6			
Hyderabad								80.0	69.2	65.6				
Karachi								90.2	76.8	58.3	43.1			
Lahore								78.8	62.9	44.3	30.6			
TAIWAN														
Province-wide <sup>1</sup>	78.4	69.2	62.9					71.8	59.8	51.6				
Taichung	80.2	68.8		57.7				78.2	65.6	56.4	48.7			
Changhua								84.3	73.8	67.8				
THAILAND														
	87.0	78.0	68.7	59.6				75.3	61.0	54.1				
TUNISIA														
								84.2	75.2	66.3 <sup>3</sup>				
UNITED STATES														
C.S.P. <sup>2</sup> Loop D: 31 mm	87.1	78.5	71.8	66.6	58.5	51.6		82.5	72.9	65.3	59.8	51.8		
Buffalo Planned Parenthood: Loop D: 31 mm	89.0	80.7	75.7	71.7	66.0	60.1								

<sup>1</sup> Rates with reinsertion computed from reported rates without reinsertion on the assumption that 50% of expulsions and 12% of other types of losses are reinserted. Empirical evidence from the Taichung program cited by Freedman and Sun, in "Who Has the IUCD Reinserted?", and by Tietze in the Cooperative Statistical Program (mainly U. S.) is the basis for this assumption.

<sup>2</sup> Computed rate based on other rates shown plus a reported rate of 73.8 after 15 months.

<sup>3</sup> Computed rate based on other rates shown plus a reported rate of 70.1 after 15 months.

<sup>4</sup> Computed rate based on other rates shown plus a reported rate of 37.1 after 30 months.

Reprinted from P. Mauldin, D. Nortman and F. F. Stephen, 'Retention of IUDs: An International Comparison', *Studies in Family Planning*, Vol. 1, No. 18 (Apr., 1967), pp. 1-12.

Table 1.17 shows that the demand for medical technology could in fact be stymied based upon the intervention itself. Regarding retention rates for IUD acceptors over a five-year period, the 1967 data showed that the rates for IUD usage dropped by roughly 30% within a two-year period when they needed to be reinserted. In other words, demand was often tempered when interventions were required over long periods of time.

Table 1.18

**ESTIMATED NUMBER OF RETAIL OUTLETS REQUIRED FOR EFFECTIVE  
DISTRIBUTION OF CONDOMS BY SIZE OF CONSUMER MARKET SERVED**

Size of City, Town & Village	Number of Population Centers	Total Population ('000)	Average Population per Center by Size-Class (col. 3 ÷ 2)	Estimated Rural Consumers Served <sup>1</sup>	Total Number of Consumers ('000) (col. 3 + 5)	Estimated Optimum Ratio of Consumer Population to Outlets	Total Number of Outlets Desired (col. 6 ÷ 7)	Desired Number of Outlets per Center (col. 8 ÷ 2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1,000,000 & over	7	14,831	2,118,714	300	15,131	650	23,278	3,325
100,000 to 999,999	106	23,346	220,245	3,750	27,096	600	45,160	426
50,000 to 99,999	137	9,325	68,066	7,250	16,575	500	33,150	242
20,000 to 49,999	477	14,444	30,281	13,500	27,944	622	44,925	94
Towns under 20,000	1,723	16,889	9,802	30,400	47,281	700	67,556	39
Large Villages with Urban Characteristics	3,817	17,300	4,532	45,000	62,300	725	85,931	23
Other Villages	544,054	340,200	625	240,000	240,000	2,400	100,000	0.18
Total	550,321	436,335	—	340,200	436,335	—	400,000	—

<sup>1</sup> We estimate conservatively that at least 30% of the 340.2 million rural population would normally buy condoms in larger places which they frequently visit for shopping and other purposes.

Source: Population data are based on 1961 Census of Population.

Note: Study to obtain data was done in 1963 and used census data for population from 1961. Reprinted from K.T. Chandy, T.R. Balakrishman, J. M. Kantawalla, Krishna Mohan, N.P. Sen, S. Sen Gupta and S. Srivastva, 'Proposals for Family Planning Promotion: A Marketing Plan', *Studies in Family Planning*, Vol. 1, No. 6 (1965), pp. 7-12.

Table 1.18 shows the popularity of family planning in India in 1963. The data was collected as part of a proposal for promoting family planning technologies. The table shows a large number of retail outlets, as well as consumers frequenting those outlets. The consumption rate for condoms was roughly 30% in 1963. Family planning technology demand was therefore not solely a female phenomenon; indeed, rates of usage seem to be about the same for both men and women during this period. This accords with broader historical trends: India during the 1950s and 1960s was becoming a more industrialised, modern society, and experiencing the same secular cultural revolution that the rest of the world was experiencing at that time.