The technological imperative for value-based healthcare

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ABSTRACT

The overarching principle of a value-based healthcare strategy is to provide higher quality care at lower cost. To achieve the goals of a value-based healthcare system is highly dependent on the availability and the effective use of technologies. This paper will explore the potential for the use of technology to enable value and the key design factors associated with their implementation in a value-based healthcare system.

ABSTRACT

The overarching principle of a value-based healthcare strategy is to provide higher quality care at lower cost. To achieve the goals of a value-based healthcare system is highly dependent on the availability and the effective use of technologies. This paper will explore the potential for the use of technology to enable value and the key design factors associated with their implementation in a value-based healthcare system.

KEY WORDS

Value-based healthcare, Digital health, Technology, Big-data, Analytics

KEY POINTS

- The complex nature of healthcare systems create a challenge for adoption of a value-based approach. Technology is an enabler which can both provide detailed

monitoring of outcomes and costs, whilst facilitating change in processes and delivery of care.

- Opportunities for technology to facilitate a value-based healthcare system needs to take into account the following trends: creating a value-enabling information technology platform, interoperability, user experience, patient empowerment, disintermediation of care and real-time analytics.

Introduction

The ultimate goal of a value-based healthcare system is to achieve "better outcomes at lower cost." (Adler-Milstein et al. 2017). Value-based healthcare is dependent on the ability to capture and evaluate outcomes and measure costs from the level of an individual patient to an entire population (Porter and Teisberg, 2006). This is challenging, as healthcare is a complex adaptive system (Wachter, 2016) where every patient is unique, but where standardisation across patient populations has been shown to be crucial to increase value (Porter and Teisberg, 2006). To meet this challenge many healthcare organisations are leveraging digitisation and technological innovation. New technology systems and approaches can support the collection, processing and dissemination of personalised information at scale due to their capability to collect patient data form different sources (e.g. primary and secondary care) and allow data to be accumulated with time (Porter and Teisberg, 2006).

It should be noted that digitising the system alone is not enough. Planning, evaluation and change management are as important as the technology itself. In addition, the increased use of technologies entails an attentiveness to technological trends and opportunities that can facilitate a value-based healthcare system. It should also be taken into account that use of new technology may also carry risk. Security and privacy related challenges remain one of the biggest concerns for creating a technology-led value-based healthcare system. This article focuses on technologies that are being used to enable a value-based healthcare system and discusses how these technologies are helping achieve

value in healthcare. The article will also outline the trends in technology that are enabling a value-based healthcare system.

How is technology enabling a value-based system in healthcare?

Transformation towards a value-based system is both enabled and informs the technology evolution of the healthcare setting. It is enabled through the ability to analyse processes at individual patient and population levels and informs digitisation through the use of this evidence to identify the next generation of solutions required for increasing value.

The widespread use of Electronic Health Records (EHR) has been one of the most significant technological advances in healthcare. EHRs are described as the "backbone" of health informatics (Porter and Teisberg, 2006), benefiting healthcare on three levels (Menachemi and Collum 2011):

- Patient e.g. iatrogenic handwriting transcription errors are immediately reduced when information, such as prescriptions, are entered electronically.
- Organisation e.g. service usage, when entered into an EHR can facilitate business planning.
- Societal (population) e.g. when implemented across organizations, EHRs can also facilitate data sharing, reducing the chance of unnecessary ordering of medical tests and improving efficiency.

The concept of an EHR, owned and siloed by an individual healthcare organization, is currently being challenged by Connected Health Records (CHR) or Personal Health Records (PHR). These concepts currently lack consensus on what they comprise. They are evolutions of the EHR that reflect:

1. The increasing delivery of care by accountable care organizations (or similar integrated care organizations in the UK); and
2. An increasingly mobile, engaged and informed patient population, who see their health records as information owned by them rather than the healthcare providers they chose to deliver episodes of their care.

Improving patient safety and outcomes by	• Using insights from the integration of different types of data (e.g. health, environment) collected by different sources (e.g. mobile devices, electronic health record (EHR)). • Using data for improved prediction (e.g. Artificial Intelligence).
Facilitate people's lives and reduce costs by	• Providing tools such as voice-assisted note taking and reminders. • Automating processes that don't need humans.
Improving healthcare delivery by	• More actively involving people in their healthcare decisions. • Providing the right information at the right time. • Giving access to healthcare like other industries such as banking and retail industry do (e.g. Amazon) by providing teleconsultation, ePrescribing and delivery of medication.

Figure 1: Same of benefits of digital technology enablement

Three contemporary technologies stand-out as having the potential to be key drivers of value-based change:

- Voice interfaces

  For many years voice transcription has been used in healthcare, but this has recently evolved to include advanced autonomous speech recognition (SR) technologies (Al-Aynati and Chorneyko, 2003). At a basic level, SR technology can already improve reporting time of patient diagnosis and thus impact quality of healthcare delivery through the "timely delivery" of care (Johnson et al., 2014).

Image 1: Amazon echo (www.amazon.co.uk)

- Internet of things (IoT) and Artificial intelligence (AI)

  Individually, and in combination, these tools have the potential to deliver advanced collection and processing of data alongside optimization of care process models. IoT refers to the concept of connectivity between different technologies, smart devices, people and places (Islam et al., 2015) and AI refers to using computer powered, intelligent technologies to perform activities that would normally require human intelligence using "minimal human intervention" (Hamet and Tremblay, 2017). Together technologies such as AI and IoT can be leveraged for behaviour change. For example, Omada, a digital therapeutics company helps organizations improve their employees health by using technology. The company uses a set of digital tools such as "scales, wearables, and a food-tracking app" to improve the health of their clients (Davis, 2017). Data from the technologies are shared with the company creating an IoT network, the company then uses machine learning (a form of AI) to "coach" individuals on weight loss and behaviour change (Davis, 2017). The healthier the employees, the lower the price the employer pays for insurance cover for them. This creates value by reducing the costs while supporting individuals to have better health outcomes.

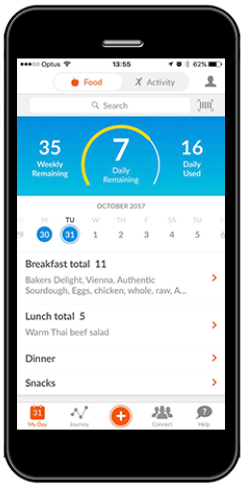

Image 2: Weight Watchers Food Tracking App (https://www.weightwatchers.com/)

Technologies used in healthcare are enabling a value-based system. This happening through digitising the system, developing current technologies such AI and IoT for use in

healthcare and collecting and analysing population-level data in a continuous way to improve services. The health technology examples mentioned above only show to what extent how technologies can enhance and improve healthcare services to achieve value in healthcare.

Trends to facilitate technology for creating a value-based healthcare system

A value-based healthcare system is user centred, therefore, it has to take into account factors that can enable a user centred care. Technologies are being leveraged to enhance user-centred designs and trends such as creating a value enabling information technology platform, interoperability, user experience, patient empowerment, disintermediation of care and real-time analytics.

To enable the use of technology for a value-based healthcare system, taking into account health technology standards is essential for the adoption of the technology. This is reflected in Porter's classic model (Porter and Lee, 2013) which is underpinned by an enabling information technology platform that:

- **Is centred on patients.** Patient centred care can contribute to the value-based healthcare system by enabling "shared decision making," health promotion and prevention and consideration of healthcare costs paid by patients (Tseng and Hicks, 2016).
- **Uses common data definitions.** Using common data definitions can allow "seamless" data sharing within an organization and between other organizations, allow universal access to data by different stakeholders (e.g. patient, primary care provider, secondary care providers) and help achieve data interoperability (Healthcare Information and Management Systems Society (HIMSS), 2015). This can also allow patients to be play a more active role in their care by easily accessing and understanding their health records (Healthcare Information and Management Systems Society (HIMSS), 2015).
- **Encompasses all types of patient data.** There are different forms of patient data, everything from physician notes taken during a physical examination, patient health

record, to test results should be kept in the same information technology platform to provide the most comprehensive patient data (Porter and Lee, 2013).

- **Comprises medical records that are accessible to all parties involved in care.** Data sharing between the different parities allows a more comprehensive view of patient data and can improve healthcare quality and reduce medical errors (Healthcare Information and Management Systems Society (HIMSS), 2015).
- **Includes templates and expert systems for each medical condition.** To provide a holistic care for patients, there is a need for more efficient ways for data entry and data viewing. Templates can help make sure that all factors needed to be taken into consideration regarding a health condition are included (Porter and Lee, 2013).
- **Has an architecture makes it easy to extract information.** An effective information technology platform should enable easy extraction of information about health outcomes during and after care to be able to monitor outcomes and help in decision making. This can be enabled by making health information from the information technology portal "readily extracted using natural language processing." (Porter and Lee, 2013)

Design and technical considerations in system implementation

Interoperability is defined as the ability of different systems to exchange and interpret data from each other and it is possible when the systems are able to exchange the data and interpret it (HIMSS, 2016). Interoperability can be achieved when different healthcare organization and systems use the same standards for data collection and sharing which allows easy information exchange between the systems (Walker et al., 2005). Interoperability-enabled information exchange can significantly contribute to the value-based system by eliminating repetition of services, eliminating use of paper, resulting in better care and consequently allowing significant financial savings (Walker et al., 2005).

According to the International Organization for Standardization (ISO), user experience (UX) is a "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" (International Organization for Standardization,

2010). UX is about the ease and comfort a user experiences when using a technology. The increase in health technology use such as medical health records introduced the concept of "user-centred design principles" to healthcare. (HIMSS, 2016). The idea is that a technology should not make a person's life harder, rather it should enhance and improve the experience of the clinician/patient rather than act as an obstacle. Athena Health, a US based health insurance provider, emphasizes how there is no one-step solution to UX as what looks like an ideal solution to one provider might not be the opposite for another (Foley, 2011). This emphasises the importance of tailoring the services to the users and holding UX as a priority for the maintenance and effective use of the technologies contributing to the value-based system.

Patient empowerment

Patient empowerment was defined as a "a multidimensional concept where communication, decision, and health care system combined together and converge in the enhancement of the patient" (Marzorati and Pravettoni, 2017). A value-based healthcare system allows patients to be more involved in decisions regarding their health which leads them to feel in control and empowered (Marzorati and Pravettoni, 2017). This can be achieved by increasing patient involvement in decisions regarding their care, involvement in healthcare research and freedom to provide consent for patient data to be used for research (Adler-Milstein et al. 2017). Examples of methods that may increase patient empowerment through the use of technology include allowing patient access to their patient records through an electronic patient portal and easily allowing patient to participate in research through a "digital infrastructure" where patient consent can be obtained electronically, and providers can easily communicate research opportunities to patients (Adler-Milstein et al. 2017).

Evaluating cost and value

Disintermediation of care can help lower costs, save time and improve healthcare. The key to disintermediation is to "automate" some of the features of a health insurance by

taking advantage of existing systems (Goldsmith, 2000). In other words, removing the third party between the patient and healthcare to reduce waiting times and costs, and to increase value. One example of disintermediation of care is the retailer-based healthcare, made available due to the availability of digital platforms. Patients get access to healthcare through their easy to access retailers such as CVS and Walmart in the USA. Both CVS and Walmart offer pharmacy services in their stores and are now offering in-store clinics. In addition, the retailers are looking to provide a "holistic care approach" where patients can be advised on health behaviour such as nutrition and given a shopping list of healthy choices which they can easily obtain the stores. This model ensures shorter waiting times, lower costs, and a more integrated care (Reenita, 2016).

The widespread adoption of such integrated digital health technologies are enabling real-time analytics of health outcomes that move from reactive to proactive care. Longitudinal data analysis allows real world data capture; use of real world evidence methods and application of advanced analytic techniques enable new means of aggregate population wide data analysis. The increased use of health technologies enable 'Big data', which characterised by large amounts of data, in various formats (e.g. data from EHRs, data from health insurance, data from wearable sensors) and data that is unable to be processed and analysed by traditional methods (Roski et al., 2014). Additionally, accumulation of such large amounts of data is allowing for new capabilities in real-time analytics. One of the real-time analytics methods; "automated analysis" of various test results such as CT scans and X-rays have made it possible to create individualized treatment for patients according to their risk factors (Roski et al., 2014). Organizations are able to create "detailed risk profile" for patients, create predictive models based on patient characteristics and come up with the most cost-effective treatment with the best care outcomes using real-time analytics methods (Roski et al., 2014) (Raghupathi and Raghupathi, 2014).

New payment and reimbursement schemes are incentivising pharmaceutical companies to create alternate mechanism for product price development. This *value-based pricing* is enabled paying for products based on the benefit they bring to the patient instead of

the cost of development. In the UK, value from a pharmaceutical drug is determined using measures such as the Quality of Life Years (QALYs) (Claxton et al., 2008). If a pharmaceutical drug is able to add 1 QUALY per £20,000-30,000 it is paid for by the health services, anything that costs above that price range is not acceptable (Claxton et al., 2008). These measures are driving pharmaceutical companies to increase value while lowering costs and are also contributing to new drug discoveries with better value.

Risks associated with increased technology integration

A health system that achieves increased capability via technology enablement must also manage issues incumbent with complex technology delivery. Increasing digitisation requires significant change and project management to ensure that initiative outcomes are aligned with expectations. Considerations including long-term adoption, sustainability, scalability and privacy are also significant areas requiring oversight, as increased digital footprints create resource demands and possibility of data breaches. The oversight of these issues is complicated in the delivery of the simplest of technology projects; in the implementation of more complex systems where there is an objective to leverage broad elements of a patient data, skills and capabilities necessary to manage these issues are vital. With careful oversight, these risks are predictable and manageable but require continuous review to ensure mitigation.

Conclusions

Now we have an overview to help understand the tools, and factors associated with the use of technology for the delivery of a value-based healthcare system. Adopting healthcare technologies are one way for creating a value-based system. There is also a need to deploy user-centred solutions (for patients and professionals) that encourage and support new models of care. In addition, risks and challenges linked to use of technology in healthcare needs to be taken into account to not be misled that the use of technology alone can enable a value-based healthcare system. Future research should focus on identifying the most effective technologies in creating value in healthcare to be able to scale up and leverage the technologies in current systems.

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