

Development and deployment of a hospital-based trauma surveillance tool for transport & unintentional injury in Zimbabwean children aged 0 to 18 years, a mixed methods study



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Abstract

Background

Injuries remain a significant public health challenge, particularly in low- and middle-income countries where more than 90% of injury-related morbidity and mortality occur. Global trends show a general decline in injury burden in response to robust surveillance, evidence-based injury prevention policies and programs and investment in national and regional trauma systems of care; however, in many low- and middle-income countries, the decline is much less pronounced and is increasing in some countries. Zimbabwe is one such example with limited to no trauma surveillance, a conspicuously rising incidence of injury-related morbidity and mortality, a strained and fragmented emergency response system and minimal injury prevention activity. There is a gap in understanding of the true burden of disease of injury, the state of and opportunities for surveillance and the specific barriers and facilitators for implementing a trauma registry in Zimbabwe that has proven challenging elsewhere in Africa. Furthermore, there is also a lack of knowledge on contextual risk factors that contribute to injuries in children for use in designing targeted preventive interventions. Lastly, there is limited data on how patients, particularly children, navigate the healthcare system in search of care for injuries.

Methods

The public health response to injury prevention entails accurately quantifying the scale of the problem, understanding the contextual and systemic risk factors contributing to injuries, developing evidence-based interventions, and implementing sustainable, data-driven strategies that can be tested, refined, and scaled up. This mixed-methods work follows the initial steps of this approach in Zimbabwe. I established the current evidence on the burden of injuries in Zimbabwe through a systematic review of published and grey

literature and a narrative review of the Global Burden of Disease estimates. I then conducted a scoping review of trauma registries from the African continent since 2000 to understand trends in variables used and describe operational and design attributes to use in design of a bespoke registry instrument. This was followed by a qualitative study among stakeholders to identify barriers to implementing trauma registries in Zimbabwe. I then conducted a qualitative study among admitted injured patients, their families and healthcare workers from central hospitals to identify contextual risk factors for common injuries and potential mitigating interventions. In the next chapter, we investigated the typology of health system patient journeys through a journey mapping methodology and the reasons for the delay along that journey. Lastly, we piloted a new instrument based on the scoping review and qualitative studies using a prospective observational study design to understand routes through the health system and delays for patients at central hospitals with injury.

Results

There were 11,603 deaths from all injuries in Zimbabwe in 2021, constituting 6.01% of all-cause deaths that year. The age-standardised death rate from injury in the country rose 28.3% from 76.19 to 97.76 per 100,000 population from 1990 to 2021. The top five causes of injury in 2021 were road injuries, self-harm, interpersonal violence, drowning and fire, and heat and hot substances. A systematic review of available data sources found significant gaps in trauma surveillance literature in the country. Available data shows significant discrepancies between different sources for the same injuries and substantial uncertainty with wide confidence intervals. I found that trauma registries in Africa are fragmented and have inconsistent definitions of variables. Registries from 22 countries were identified. A long list of 189 discreet variables was extracted, and a “core” set of commonly occurring variables from the existing literature emerged, with 45 variables

occurring in at least 30% of registries. I also identified several barriers to implementing a trauma registry in Zimbabwe, including resources (consumables and operational resources, financial, human resources, technology infrastructure), operational, regulatory, data and utility barriers. Patient journey mapping revealed four distinct typologies of patient care pathways and prolonged delays in accessing care for injuries. We identified contextual risk factors for burns and road traffic crashes, including systemic, environmental and individual. Finally, I piloted a bespoke trauma surveillance tool in three central hospitals in Zimbabwe, which successfully captured critical data on patient flow and delays in the injury journey. However, data completeness for vital signs (2%-12%) and events in the emergency department (32%-56%) were poorly documented. Median care-seeking interval, health-system interval and treatment interval were 1 hr 40, 2 hr 30 and 3.1 days, respectively, for all injuries. The care-seeking interval for burns was significantly higher than for fractures and visceral injuries.

Conclusion

This study highlighted the urgent need for accurate, granular data on paediatric injuries in Zimbabwe. Through a systematic review, a scoping review, qualitative studies and the development of a bespoke hospital-based trauma surveillance tool, we have shown that despite the limitations of existing data sources, the burden of disease in Zimbabwe is substantial and appears to be increasing. Multiple barriers plague implementation of a trauma registry however there are opportunities for obtaining buy-in, ensuring sustainability and ensuring quality data collection. This trauma registry has demonstrable utility for mapping health system delays and movements of patients through different levels of care. It could potentially help inform policy for better allocative efficiency and delivering accessible, affordable and effective trauma care in Zimbabwe.

Dedication

I want to dedicate this thesis to the following people, without whom this would not be possible:

To my wife, Tanya—my rock, greatest supporter, and partner in everything. Thank you for your patience, your sacrifices, and your unwavering belief in me throughout this journey. You have borne the weight of this process with grace, standing beside me through the long nights, the challenges, and the victories. Your love and support have been my anchor, and this achievement is as much yours as it is mine.

To my mother, Thembiwe C Mazingi, whose love, sacrifices, and prayers have protected me and been my guiding light. I would have never got to this point without you; your strength and resilience inspire me daily. To my father, I wish you could have been here to see this day and celebrate with us.

To my sisters, Mellisa and Vuyelwa, my greatest cheerleaders. Your support, encouragement, and belief in me have been a source of motivation throughout this journey.

To my grandmother, Grace Busisiwe Chikosi, whose prayers still echo in my life, shaping my path with wisdom and grace.

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This work is a testament to all of your love, your faith in me, and the foundation you have built beneath my feet. I am forever grateful.

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This thesis is a testament to the collective efforts, wisdom, and support of so many. I am forever grateful.

Declaration

I confirm that this thesis is entirely my own work and has not been submitted for any degree or professional qualification at this or any other institution.

This thesis is submitted in fulfilment of the requirements for the degree of Doctor of Philosophy (DPhil) at the University of Oxford.

Except where otherwise stated, this work is the result of my own research and includes no material previously published or written by another person, except where due reference is made.

Signed:

Dennis Mazingi

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List of abbreviations

WHO - World Health Organisation

LMICs – Low- and middle-income countries

HIC – high income countries

HIV - Human immunodeficiency virus

YLL - years of life lost due to premature mortality

YLD - years of healthy life lost due to disability

DALYs - Disability-adjusted life years

SDGs – Sustainable development goals

ED - emergency department

EMS – emergency medical services

EuroTARN - European Trauma Audit and Research Network

NMTR - National Major Trauma Registry

NTDB - National Trauma Data Bank

ISS – injury severity score

KTS – Kampala Trauma Score

Statement of Reflexivity

I come to this research project with a complex positionality that encompasses both the emic (insider) and etic (outsider) perspectives. As a Zimbabwean doctor who trained and practiced as a surgeon within this same healthcare system that is the subject of my research, I primarily approach this research from an insider's position. I come with knowledge, biases, and preconceptions from that experience. As a researcher based at the University of Oxford, I have some characteristics of the emic perspective. This dual identity as both researcher and former clinical practitioner within the study context has significantly influenced the conceptualization, execution, and interpretation of this research.

My medical training and surgical background have fundamentally shaped my ontological viewpoint, which stems predominantly from a deeply rooted pragmatic realist paradigm. Having been educated within a biomedical framework, I tend to prioritize empirical evidence and favour practical, solution-oriented approaches to healthcare challenges. This has influenced my methodological choices including the focus on actionable barriers and facilitators, direct risk factors and policy actions. During analysis I reflected on a tendency to gravitate towards those analyses that may translate into actionable, tangible system improvements potentially at the expense of more theoretical exploration of concepts. Even though I had not worked in the Zimbabwean health system for the duration of my DPhil, I remained culturally and professionally embedded within its context and maintained my previous relationships. This was an advantage in facilitating access to research sites, participants, cultural and linguistic fluency and understanding of subtext and unspoken nuance, it also may have led to normalising conditions in the health systems, barriers for patients, structural deficiencies and operational norms that I may have become accustomed to, while these may have immediately stood out to an outsider researcher. I

had to include an additional researcher with the etic perspective to read through transcripts and question my unconscious assumptions and interpretations wherever possible. I was however careful not to introduce harmful tropes about health care systems in LMICs that may sometimes emanate from the etic perspectives that include narratives of the “global south” as places of failure or that see deviations from the western paradigm of health systems as bizarre. I wanted to be open to discovering innovations that may have something to teach the “global south” and “global north” alike. As an insider I may have been vulnerable to the same reluctance to pursue a line of enquiry that may be critical of government policy and actions.

There was a significant power dynamic inherent in my position as a medical practitioner and researcher at the University of Oxford (a large, western educational institution). This likely influenced how participants responded to me. To patients I may have been practically indistinguishable from their own doctors despite assurances that I was not involved in their care and to medical students or junior doctors and nurses this may also have led to caution on their part in answering questions. The doctor-patient power differential in Zimbabwean society cannot be completely neutralised.

My motivation to undertake this work stems from my time working as a doctor in Zimbabwe and during surgical training and having witnessed firsthand the burden and impact of injuries and the challenges faced. Thus, my motivation is not purely academic but emerged from professional concern. However, there is a risk of confirmation bias where I may seek answers that align with my preconceived notions about the system, its deficiencies and the barriers.

I have acknowledged my medical background that shapes my axiological assumptions that tends to value quantifiable outcomes and pragmatic solutions. I thus had to try to expand my perspective and seek patient-centred and participatory methodologies. This is reflected

in the large portion of this work devoted to qualitative work. As a surgeon whose job is concerned with treatment after the fact (secondary and tertiary prevention) I am predisposed to view health system challenges through the lens of individual clinical interventions rather than primary prevention or even primordial prevention. Having worked however in central training hospitals in urban centres exclusively in one major city also may have influenced the focus on central hospitals in my work. This was also influenced by practical considerations such as resource constraints and logistical barriers. The rural perspective and the experiences of the primary care and secondary care levels is equally if not more important in the Zimbabwean context and are often left out. In this I acknowledge my own personal bias and privilege not only as a student based in Oxford but even as a local medical practitioner educated at the local university in Harare. This must be rectified in future work where more resources become available. I tried to create a gender balance between the two independent coders and interviewers where possible in qualitative studies.

Over the course of time performing this research, I have gained new perspective on the difficult journey that patients take to navigate their search for care and have a newfound respect for their resilience and inventiveness.

CHAPTER 1: Introduction

1.1 Global Context of Injuries

Injuries represent a significant public health challenge worldwide, causing over 4.3 million deaths annually, surpassing the combined toll of human immunodeficiency virus (HIV), tuberculosis, and malaria. (1) This accounts for 6.4% of global fatalities and 11.5% of years of life lost (YLLs) in 2021. (1) Despite the alarming burden, injuries continue to be under-prioritized in global health discourse, particularly in low- and middle-income countries (LMICs), where 91% of injury-related fatalities occur. The disparity is exacerbated by limited resources for prevention and care. While high-income countries (HICs) have achieved significant reductions in injury-related morbidity and mortality through evidence-based primary prevention interventions and robust trauma health systems, progress in LMICs, particularly in Africa, remains slow. Zimbabwe exemplifies this trend, with rising injury burden rates over the past three decades, in stark contrast to global declines. (2) Injury perpetuates poverty and inequality in human health on an individual, community and global level (3) and the most affected age group is the young productive age group who are the custodians of the future social and economic productivity of these nations. In 2019, injuries encompassing road traffic injuries, unintentional injuries and self-harm and interpersonal violence together represented more than 40% of the total number of deaths in this important age group, globally (10 to 24 years of age) (4). Notwithstanding this injury risk persists across the entire life-course from early childhood through adolescence and adulthood to older ages (5).

The urgent need to prioritise injuries has been reflected in numerous global actions: the sustainable development goals, which represent global aspirations for human wellbeing and development aimed to halve the number of global deaths and injuries from road traffic

accidents by 2020, while the so called “The Decade of Action for Road Safety 2011-2020” also aimed to stabilise and reduce the predicted level of traffic fatalities in low and middle-income countries by 2020. Similarly, the new “Decade of Action for Road Safety 2021-2030” represented a reaffirmation of that commitment for the next decade. The death rate of injuries has not declined in line with expectations globally and unfortunately this pattern is mirrored on the national level in many countries. Injuries have received comparatively lower attention than other health issues such as infectious diseases (6) despite the fact that Injury killed 1.7 times more people globally in 2021 than HIV, tuberculosis and malaria combined. (1)

1.2 The Zimbabwean Context

Zimbabwe is a small southern African lower-middle income nation, with a population of almost 16 million in 2021 that is characterised by a young, growing mostly rural population (67%). (7) It has experienced significant economic, political and social turbulence in the last 20 years with accompanying health system headwinds (8). There is a significant burden of infectious and increasingly non-communicable diseases (9) as expected for an industrialising African nation. Injury, however is revealed as a third important but neglected component in a triple burden of colliding epidemics in the country (10). Injuries reportedly accounted for as high as 15 percent of all deaths in 1988 (11) while Zimbabwe had the highest road crash mortality rate amongst its neighbours in 2016 (12). Despite the considerable effort expended in injury prevention around the world, progress since then in Zimbabwe has been slow. The country is one of the handful of countries that have conspicuously recorded an *increase* in age-standardised all-injury disability-adjusted life year (DALY) rates in the past 3 decades while the rest of the world has recorded significant *decreases* (figure 1 and figure 2) (13). Injury is a health threat that is preventable using a raft of well-known evidence-based interventions (14). However, a

crucial first step in tackling the problem is availability of detailed health data to inform policy makers and health system planners as well as facilitating advocacy (15). There is a significant gap in the trauma surveillance, management and prevention literature in the country (16) and the true burden of disease of injury is difficult to obtain. Official injury statistics may significantly underestimate the problem for example, official road accident fatalities in 2017 were reported around 2000 deaths per annum while the WHO estimates the true figure is closer to 7000 deaths annually, more than three times the official figures (17). In early 2022, the World Health Organisation lamented the “gaps in data availability and accuracy” in trauma surveillance in Zimbabwe and repeated the clarion call for establishment of “an integrated and coordinated database” in the country (17) that were made as early as 1993 (11).

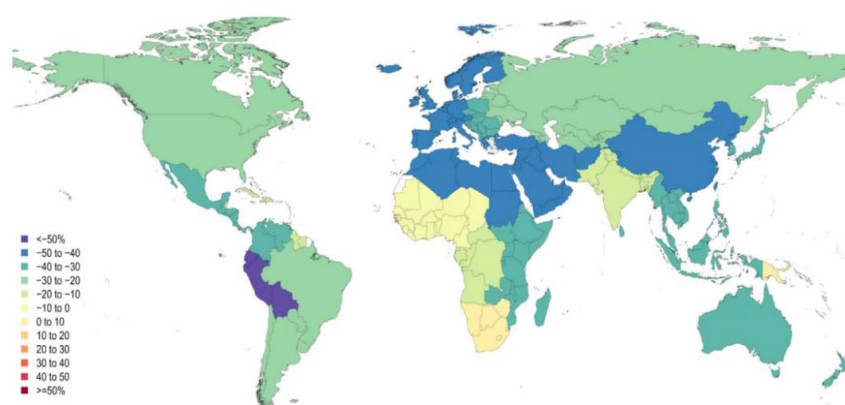


Figure 1. *Percent change in age-standardised, all injury disability-adjusted life year rates 1990 – 2013. (13)*

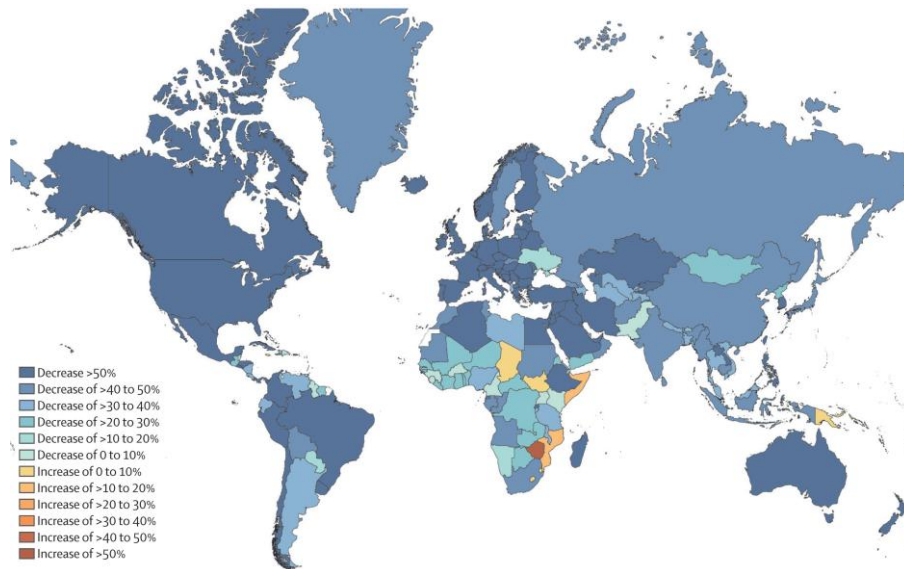


Figure 2. Unintentional injury deaths per 100000 population in adolescents aged 10–24 years from 1990 to 2019. (2)

1.3 The public health approach to injury prevention

The overarching framework for this thesis is the public health response to injury. The public health model was first developed during the early 19th century related to efforts to address infectious diseases such as cholera and tuberculosis during the industrial revolution (18). Over time this approach was adapted to other conditions such as non-communicable diseases, and environmental hazards. It was first adapted for injuries by Mercy et al in 1993 in response to increasing recognition of injury as a public health problem that was growing at the time (19). It describes a systematic process, (fig 3) that proceeds through definition of a problem, identification of risk and protective factors, development and testing of prevention strategies and scaling and dissemination of interventions. Zimbabwe is at the beginning of its injury prevention journey and requires a systematic approach to addressing this problem in the country. Acknowledging this, in this thesis I proceed through the initial two steps of the public health response to injury prevention as shown in figure 3.

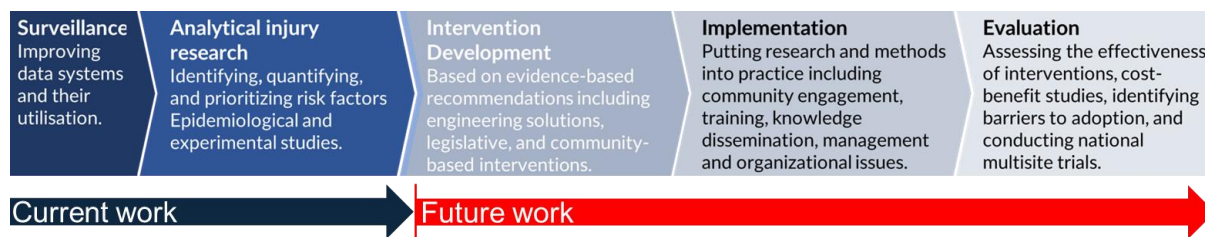


Figure 3. The public health response to injury prevention.

1.4 Trauma surveillance

Trauma surveillance is a critical component of public health systems, providing the data necessary for understanding injury patterns, designing preventive strategies, and evaluating interventions. Trauma surveillance is a key first step to address the injury burden (figure 3). Trauma surveillance can be performed at the community level or the health care facility level and can consist of purpose-built research, periodic population-based surveys or as ongoing collection of data as trauma registries.

The relative neglect of injuries as a public health priority and the inherent difficulty in enumerating injury burden have led to imbalances in disease surveillance which present real threats to prevention efforts. For example, injury data collection and quality has been relatively poorer than for other disease conditions such as HIV or Malaria and hence the recorded burden is underestimated relative to these and other conditions. (20) In many countries' prioritisation of health investment and action is based on ranking of the burden of disease in each country and because of the relatively poorer injury data collection, injuries rank lower and then receive comparatively less investment. There is precedent for improved availability of data on injuries changing prioritisation in a national health agenda. For example, in Australia, data collected through state-level trauma registries and other trauma surveillance systems identified road traffic injuries as a major public health

issue. (21) This data influenced legislative changes, including mandatory seatbelt laws, drink-driving countermeasures, and public awareness campaigns, which significantly reduced injury mortality rates over time. In Bangladesh where child conditions such as malnutrition, diarrhoea and lower respiratory tract infections dominated discourse a concerted effort to survey injuries led to the realisation that drowning was a leading cause of death in the country. The Bangladesh Health and Injury Survey led to changes in government health priorities and implementation of government programmes aimed at drowning. Another major source of data quality imbalance stems from the disparity in coverage and quality of mortality estimates between different countries. While HICs have near complete coverage of deaths and births, LMICs particularly in Africa have poor death registration coverage reaching as low as 20% in some countries (figure 4), meaning the burden may be much higher than currently thought.

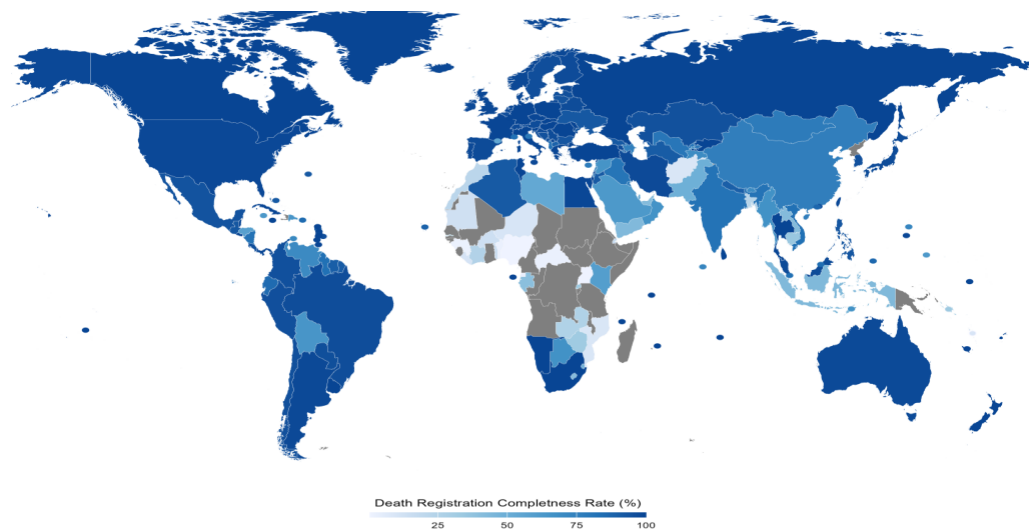


Figure 4. Death registration completeness by country (22)

Trauma registries

While population-based injury surveys are resource intensive and relatively infrequent, trauma registries are a major, almost real-time source of data on injuries, their risk factors

and outcomes. Trauma registries, defined as “ongoing, dynamic systems for collection of standardised data for individuals sustaining injuries based on uniform data elements” (23) (24) play a pivotal role in this surveillance enabling quality benchmarking, monitoring of intervention strategies and the shaping of policy and clinical practices. Despite their established utility in high-income contexts, where sophisticated national networks of trauma registries exist (Table 1), Africa has lagged behind substantially in the development and implementation of such crucial systems. The need for trauma registries on the continent is urgent, given the already high mortality rates and the fast-approaching sustainable development deadlines.

History, implementation and fragmentation of trauma registries

The development and implementation of trauma registries has evolved significantly since their inception in high-income countries where they have contributed substantially to the observed reduction of trauma mortality and morbidity in these countries. The first computerised trauma registry was an institutional registry established at the Cook County Hospital in Chicago in 1969 (5) (6) as part of a wave of recognition of injury as a significant problem and the development of ‘trauma centres and systems at the time. This first registry became a prototype for many of the institutional registries that followed in its wake and eventually for a state-wide trauma registry comprising many hospitals.

Institutional registries were in many cases required to report their data to higher levels of data repositories and this was eventually facilitated by a common set of standards for collection and reporting of data (7). Reporting of registry data to a designated authority is a core function of institutional trauma registries and allows for pooling of multicentre data. Eventually scale-up from institutional to regional and state levels resulted in the formation of the National Trauma Data Bank (NTDB), which brought together and standardised trauma registry data from trauma centres and trauma systems across the U.S. Today the

NTDB represents the most extensive collection of trauma registry data ever compiled, featuring over one million records from 405 trauma centres across the USA. Over time increasing sophistication and coverage of trauma registries in other countries around the world has occurred with similar consolidation of institutional and regional registries into national networks with standardised guidelines and datasets. Established trauma registries such as the National Major Trauma Registry (NMTR) in the United Kingdom, the Australasian Trauma Registry and the NTDB have set benchmarks for best practice in trauma surveillance, showcasing the utility of these tools to improve patient care and guide policy. These registries are characterized by their comprehensive data collection, which spans the whole continuum of trauma care from pre-hospital to post-discharge phases, their near-national coverage and methodological rigour to ensure data collection reliability as much as possible. The previously mentioned process from establishing strong institutional registries to scale up to regional, state and national levels and transnational consolidation is common to many countries, and we aim to accelerate a similar process in Africa.

Table 1 Regional and national trauma registries around the world (modified from Tohira et al) (8).

Continent	Country	Registry	
North America	USA	National Trauma Data Bank (NTDB)	
	Canada	National Trauma Registry (NTR)	
Europe	United Kingdom	National Major Trauma Registry (NMTR)	
	17 European countries	European Trauma Audit and Research Network (EuroTARN)	
	Austria		
	Czech Republic	The Czech Republic Register of Injuries (URCR)	
	France		
	Australia New Zealand & Australia	Australia	Victoria State Trauma System (VSTS)
		New Zealand	New South Wales trauma registry (NSWTR)
		Australia	Queensland trauma registry (QTR)
			South Australia trauma registry (SATR)
			National Trauma Registry Consortium (NTRC)
Latin America & Caribbean	Jamaica	The Jamaica Trauma Registry	
	4 countries	Caribbean Neurotrauma Registry (LATINO-TBI)	
Middle East and Asia	Japan	Japan Trauma Databank	
	Malaysia	National trauma database	
	UAE	The Abu Dhabi Trauma Registry	
	Israel	Israel Trauma Registry	
	Singapore	The National Trauma Registry	
	Iran	National trauma registry of Iran	

Despite the proven success of trauma registries in high-income countries, they have been met with numerous challenges in Africa (25) (26). One of the first institutional registries in Africa was established in 2000 in hospitals in Uganda (27). Since then and with the publication of the World Health Organisation's injury surveillance guidelines (WHOISG) soon after (28), the trauma registry literature has grown considerably worldwide but Africa remains relatively underrepresented in the body of literature (26) (29). More recently there has been increasing momentum to urgently establish new registries in Africa with varying degrees of success (30) (31). Identified barriers to implementation of trauma registries in LMICs include resource constraints (financial and human resources), limited adoption, and difficulty in sustainability (26), however context-specific implementation barriers and

facilitators are unknown in Zimbabwe. The development of abridged registry tools as well as the deployment of novel technologies have tried to mitigate these challenges with varying degrees of success, (32) (33) however progress appears to be slow.

With increasing development of major national and continental trauma registries outside of Africa, efforts to develop a standard for comparison of trauma data across different countries have continued. Aggregation of national data from the U.S., Canada, United Kingdom, and Australia resulted in the publication of the ‘major trauma outcomes study’ (MTOS) in 1982 which was the first to pool data from that many sources and required a considerable amount of standardisation to make this data comparable. Meanwhile, the major registries in Europe were involved in major consensus efforts to develop and improve the Utstein Template for Uniform Reporting of Data following Major Trauma, which is meant to assist with the comparison and compatibility of data in disparate registries. The same will be required in the future for Africa.

1.5 Trauma health systems

A trauma system is defined as “an organized, coordinated effort in a defined geographic area that delivers the full range of care to all injured patients and is integrated with the local public health system.” According to the American College of Surgeons, trauma systems includes “injury prevention and control, public health, emergency medical services (EMS) field intervention, emergency department (ED) care, surgical interventions, intensive and general surgical in-hospital care, and rehabilitative services, along with the social services and the support groups that assist injured people and their significant others with their return to society at the most productive level possible.” (34) It emphasises a whole systems approach to injury prevention care and rehabilitation and prioritises efficiency and integration with the rest of the health system. Trauma systems around the world have varying maturity and sophistication (35); however, the aim is to prevent, treat

and rehabilitate trauma in a timely and safe fashion based on their unique geographical and socioeconomic context. The WHO Trauma System Maturity Index classifies trauma systems worldwide into four levels, from I (least mature) to IV (most mature), based on their score for various trauma system components. Zimbabwe scores II for level of prehospital trauma care, I on level of facility-based trauma care, and I on level of education and training and has no dedicated level-1 trauma centres (35). Despite the long years of substantial injury burden, the country is, therefore, still at the beginning of its injury prevention and trauma health system development journey. Zimbabwe has a centralised health care system with reliance on central, highly specialised hospitals, where a high concentration of human resources, training, infrastructure and equipment capacity in urban cities is concentrated, despite the fact that many patients come from outside these urban cities. As with care for many conditions, treatment of trauma in higher, centralised levels of care has theoretical benefits in that patients benefit from highly specialised care. However, it also means longer time to care and treatment for patients far away from their homes and familial support systems that provide financial, psychological and other help. It may also reduce overall allocative efficiency in the whole health system because of potentially overstretched central hospitals and underutilised lower levels of care. Trauma outcomes can be significantly improved with a raft of simple, cost-effective interventions such as intravenous fluids and splinting of fractures, as well as relatively simple diagnostics such as X-rays and ultrasound that can be delivered at lower levels of care (36). The current utilisation of the higher levels of the health system in Zimbabwe and the best way to allocate resources to deliver trauma care in the country is unknown.

In this thesis, we will begin with a treatise of the current state of trauma surveillance in Zimbabwe in chapter 2. Through a systematic review of trauma data sources and a narrative summary of the latest global health estimates, we aim to compile all of the extant

literature containing information on the burden of trauma in Zimbabwe and compare and critique these sources as well as characterise discrepancies in the available data sources.

In chapter 3, recognising the importance of trauma registries in providing good quality information on injuries, we aim to learn from the experiences of other African countries in designing and developing trauma registries through a scoping review. In the next chapter, qualitative chapter 4, we explore past and present barriers and facilitators to implementing a trauma registry in Zimbabwe. In Chapter 5, we then explore context-specific risk factors for common causes of childhood trauma in the country and identify potential mitigation for them. In chapter 6, we explore the patient journey to trauma care through the trauma system as well as barriers and facilitators along that journey. Finally, using the information from the preceding chapters 2, 3, 4, 5 and 6, we pilot a bespoke trauma registry instrument in three major Zimbabwean hospitals to quantify patient flow through the trauma system to definitive care.

Thus, this work will focus on the first two steps of the public health response to injury prevention as they relate to children in Zimbabwe, a country where injury prevention efforts are nascent. In other words, the overarching objectives of this work are:

- To understand the burden of disease of injuries in Zimbabwe and the state of trauma surveillance in the country, chapter 2.
- To learn from the experiences of other African countries in trauma surveillance through trauma registries in designing a bespoke trauma registry chapter 3
- To understand implementation barriers and facilitators to trauma surveillance in Zimbabwe, chapter 4.

- To identify and quantify risk and protective factors for common childhood injuries in Zimbabwe and identify potential areas for intervention for childhood injuries, chapter 5.
- To map the journey of patients through the trauma health system in Zimbabwe, identifying barriers and quantifying delay, chapter 6 and 7

CHAPTER 2: The burden of disease of injury in Zimbabwe: a systematic review of sources and findings from the Global Burden of Disease Study 2021.

2.1 Background

Injury is a health threat that is preventable using a raft of already well-known evidence-based interventions. (14) However, a crucial first step in tackling the problem is availability of detailed health data to inform policy makers and health system planners as well as facilitating advocacy and designing interventions. (15) There is a significant gap in the trauma surveillance, management and prevention literature in Zimbabwe (16) and the true burden of disease of injury is unknown. Currently available estimates for injuries in many countries are thought to be underestimates relative to other causes of disease and this may lead to low priority of injury on national health policy agendas (37). Underreporting of deaths due to road injury (37) and violence (38) in local statistics, for example, is well described globally.

Global health estimates are made by collating significant data sources of variable quality and making various assumptions and trade-offs to compensate for data gaps. (39) These choices are made to maximise the accuracy of global estimates. Still, they may affect the accuracy of estimates on the country level, which are more influential in policymaking, particularly in data-sparse countries. Zimbabwe is one country with such low data availability. (37) It is, therefore, important to critically analyse estimates on a country level and understand the quality of underlying data and the appropriateness of assumptions made.

2019 is an important fiduciary point for injury prevention as it is the last year before the COVID-19 pandemic, which substantially affected injury burden globally (40) while 2021 allows for assessment of the beginning of the post-COVID era concerning injury burden. This period also marks the end of the first “decade for action on road traffic accidents” and one third of the way towards the 2030 agenda for sustainable development. It is apt that we take stock of progress towards global and national SDG aspirations. This article summarises the findings from the Global Burden of Disease 2021 (GBD-2021) study on injury in Zimbabwe from 1990 to 2021. We also critically analyse the data underlying these estimates.

2.2 Chapter Aims and Objectives

2.2.1 Aims

To provide a comprehensive overview of injury data sources in Zimbabwe, assessing their availability and quality and estimating trends in the burden of injuries in the country.

2.2.2 Objectives

To conduct a systematic review to identify and synthesise all the available literature and data sources on injury epidemiology in Zimbabwe.

To assess the strengths, limitations and gaps in data sources for injury in Zimbabwe.

To evaluate discrepancies between locally reported data and global health estimates and explore reasons for these.

2.3 Methods

2.3.1 Data sources and search strategy

This review included published peer reviewed articles, government reports, national databases, grey literature, dissertations and global health databases. We used an a priori review protocol published [previously](#) (16) and described here with amendments from the original protocol. We searched the following databases: PubMed, Google Scholar, and SafetyLit and we also conducted snowball searches based on the reference lists of the retrieved articles and hand searched for specific known grey and white literature sources including unpublished dissertations. We also hand searched the following grey and white literature sources: the “Integrated Public Use Microdata Series database” (IPUMS), the “International Household Survey Network” and the “Monitoring and Evaluation to Assess and Use Results Demographic and Health Surveys database”, Zimbabwe government websites, reports from the Ministry of health, the Zimbabwe Republic Police (ZRP) and the Traffic Safety Council of Zimbabwe to find surveys and censuses containing potential data points relevant to injury in Zimbabwe.

Inclusion criteria

- Published and unpublished works that provide data on mortality, morbidity, or disability from injuries.
- Sources reporting injury epidemiology data on Zimbabwe from 2000 to 2021

Exclusion criteria

- Sources reporting data from outside of Zimbabwe
- Sources reporting clinical characteristics, management or rehabilitation of injuries without providing epidemiological data.

We used the following search strategy: (((injur*)) AND (Zimbabwe)) AND ((“2000”[Date - Publication]: “2023”[Date - Publication])) and assessed articles for data collection related to any injury.

The retrieved sources were collated and uploaded into Rayyan© reference management software. Two screeners screened abstract and full text with a third independent reviewer resolving conflicts in inclusion decisions. We extracted relevant microdata and metadata from the identified sources and estimated the incidence of injuries from these sources.

Additionally, we extracted Global Burden of Disease estimates released in [2021](#), 2019 and 2017 from IHME’s Global Health Data Exchange (<http://ghdx.healthdata.org/>) and cause of death models tool from GBD 2021 (<https://vizhub.healthdata.org/cod/>) to estimate the burden of injuries in Zimbabwe. We used this data to estimate mortality, disability and DALYs for all available age-groups, and causes of injury.

The methodological approach used by the Global Burden of disease study has been published previously mainly as they pertain to injury. (1). In GBD 2021, diseases and injuries were organised using a 4-level hierarchy from the broadest level 1 causes to the most specific level 4 causes. Causes are based on the International Classification of Diseases (ICD) and are corrected for misclassification, miscoding and under-reporting (1). GBD 2021 broadly classifies injuries (level 1) into ‘transport injuries’, ‘unintentional injuries’ and ‘self-harm and interpersonal violence’ (otherwise known as intentional injuries) at level 2. The relevant ICD codes are E800-E999 and ICD-10 chapters V–Y. This excludes deaths from drug overdoses and accidental alcohol poisoning that are classified elsewhere.

The GBD 2021 study health estimates are based on multiple underlying data sources identified through a systematic review of published studies and published and unpublished

reports of governments and international organisations. Specific sources relevant to injury include civil registration and vital statistics (CRVS), verbal autopsies (VA), and disease registries. Other potentially valuable sources that are not used in GBD mortality estimation include censuses and household surveys. Injury mortality data in Zimbabwe primarily comes from published government reports (the national health profiles) on national mortality collated from police and crime reports and the vital registration system. A list of the injury data sources used in GBD 2021 for Zimbabwe is provided in Appendix 1. VA involves interviews with the deceased person's next of kin or caregivers using a standardised questionnaire on the symptoms and circumstances leading to death to ascertain the likely cause of death. CRVS systems are systems that are intended to register all vital events such as births and deaths, issue birth and death certificates, and compile and disseminate vital statistics, including cause of death information. Police data that meet GBD inclusion criteria and are nationally representative are used in road injury and interpersonal violence deaths estimation (1) however it is unclear whether Zimbabwe police data was considered eligible.

Statistical analysis

All rates were age-standardized applying the GBD global-age-structure which allows for comparisons over time regardless of the change in size and age structure of the Zimbabwean population. Estimates are reported as point estimates with their associated 95% confidence intervals. The uncertainty in the estimates provided by GBD is reflected in the confidence interval provided. To compare the uncertainty of modelled estimates between GBD revisions we calculated the coefficient of variation for each point estimate. The coefficient of variation is a standardised measure of dispersion of a distribution. We calculated the coefficient of distribution from the following formulae.

$$SE = \frac{\textit{upper bound} - \textit{lower bound}}{2 \times 1.96}$$

$$CV = \left(\frac{SE}{\textit{mean estimate}} \right) \times 100\%$$

SE = Standard Error

CV = coefficient of variation

2.4 Results

Data sources identified.

The literature search found 81 publications with potentially relevant injury data points (Figure 5) (Appendix 1). Based on a review of the title, abstract and full text of citations, we identified 4 sources that provided a nationally representative data estimate of injury burden in Zimbabwe. We also identified 5 sources that were potentially useful for providing this data in the future. We found 1 limited source of nationally representative data for nonfatal injuries. We also found 1 source of subnational data for road injuries in one province.

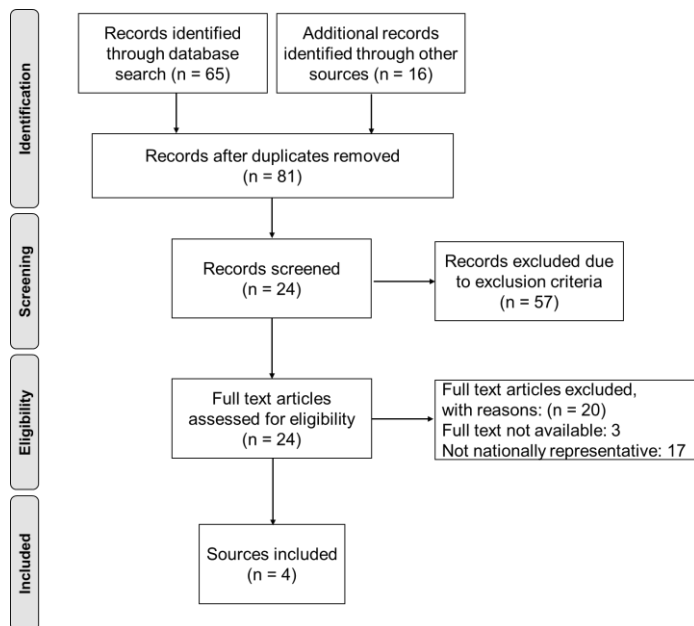


Figure 5. PRISMA diagram for systematic review of trauma data sources in Zimbabwe.

Nationally representative data was identified for road injury, unintentional injuries, and violence in Zimbabwe. We plotted these estimates for injury with estimates from successive iterations of the global burden of disease study (GBD) 2017, GBD2019 and GBD2021.

Comparisons of estimates and confidence intervals

The estimates for injury deaths from successive GBD revisions exhibited substantial variability. The confidence intervals were wide and widened over time, particularly after 2012-2013, reflecting the absence of new sources of underlying data after that period. The GBD 2019 and 2017 estimates diverge after 1995, and their confidence intervals do not cross for 5 years from 2001 to 2006, signifying a significant difference in the mortality estimate (figure 6). There was a similar discrepancy in estimates for road crash deaths. WHO global health estimates were more than 3 times higher than local statistics. Local statistics for unintentional injury were unavailable from the identified literature or

government sources. The confidence interval for modelled estimates for the global status report for violence prevention are extensive, with an upper confidence range of 4 times the point estimate. The confidence intervals were analysed as the coefficient of variation to understand the uncertainty in the modelled estimates. The coefficient of variation increases after 2014 and is also lower in GBD-2021 vs GBD-2019. For ‘all injuries’, the coefficient of variation similarly increases with time after 2014 (figure 7).

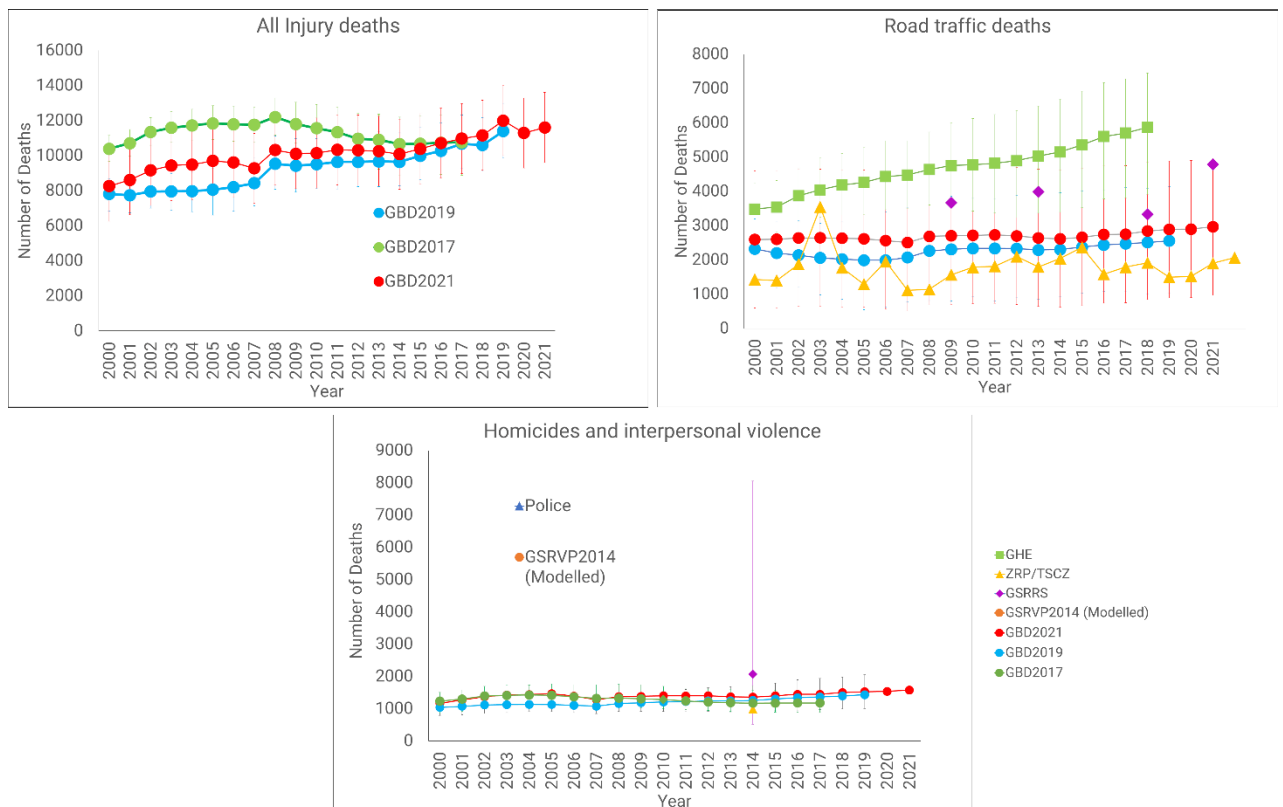


Figure 6. Comparisons of identified national-level local statistics, Global burden of Disease estimates, and Global Health Estimates for all injury deaths (a), road traffic crash deaths (b) and interpersonal deaths (c) in Zimbabwe from 2000 to 2021.

*ZRP = Zimbabwe Republic Police; TSCZ = traffic safety council of Zimbabwe; GSRRS = global status report on road safety; GSRVP = global status report on violence prevention; GBD = global burden of disease

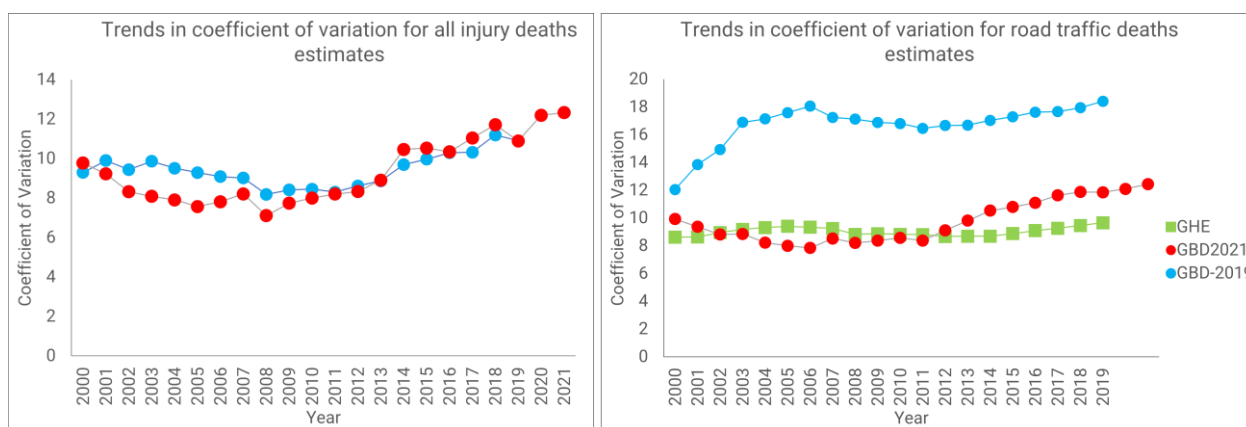


Figure 7. Trends in coefficient of variation for modelled estimates

Narrative summary of GBD 2021 estimates for Zimbabwe

National overview of injury mortality in Zimbabwe

The total number of deaths from all injuries in Zimbabwe in 2021 was 11,603 (95% uncertainty interval 8,875 to 14,627), which constituted 6.01% of all-cause deaths (7.01% to 5.11%). The age-standardised death rate from injury in the country rose from 76.19 per 100,000 (64.43 to 88.97) in 1990 to 97.76 (75.81 to 122.61) per 100,000 population in 2021. While mortality rates of major communicable diseases HIV/AIDS, tuberculosis and malaria have experienced sustained declines since their peak in the early 2000s, injury death rates have increased at the same time. Zimbabwe ranks 25th out of 54 African countries in age-standardised unintentional injury death rates (35.28 deaths per/100 000, 95% UI: 27.77 to 43.93); 24th out of 54 in age-standardised road injury death rates (35.28 deaths/100 000, 95% UI: 21.84 to 35.14) and 7th out of 54 in ‘self-harm and interpersonal violence’ age-standardised death rates in Africa (34.49 deaths/100 000, 95% UI: 24.40 to 44.58). The country is the 13th highest (out of 54) African countries in age-standardised all-injury death rates and 22nd out of 204 countries and territories around the world enumerated in GBD data with 97.76 deaths per/100 000, 95% UI: 75.81 to 122.61).

Injury deaths by cause

In 2021 the 5 causes of injury with the highest number of deaths in all ages were road injuries, self-harm, interpersonal violence, drowning and 'fire, heat, and hot substances.' In 1990 the number of road injury deaths was 1 656 (1 389 to 1 959) or a rate of 16.01 per 100 000 population (13.43 to 18.94) increasing to 2 966 (2275 to 3793) deaths representing a death rate of 19.01 per 100 000 population (14.59 to 24.32) in 2021. Self-harm led to 882 (576 to 1 304) deaths in 1990 representing a rate of 8.53 per 100 000 population (5.57 to 12.61) while in 2021 the number of deaths from self-harm increased to 2743 (1805 to 3642) and the mortality rate increased to 17.59 per 100 000 (11.57 to 23.35). In 2021 the number of deaths from interpersonal violence rose from 645 (433 to 779) to 1581 deaths (1145 to 2115) in 2021 and the mortality rate rose from 6.24 per 100 000 (5.15 to 7.54) in 1990 to 10.14 per 100 000 (7.35 to 13.56) per 100 000. The mortality rates for drowning and 'fire, heat, and hot substances' in 2021 were 5.69 (4.33 to 7.28) and 5.26 per 100 000 (3.83 to 6.93) respectively. These and other causes of injury in Zimbabwe in 2021 are shown in Figure 8. Reflecting progress in sustainable development indicator 3.4.2 (Suicide mortality rate), the death rate due to self-harm in 2015 has reduced by 4.27% (to 16.84). The progress in SDG indicator 3.6.1 (number of road injury deaths has increased by 1.28% from 18.77 per 100 000 in 2015). For SDG Indicator 3.9.3, the mortality rate from unintentional poisoning has increased by 2.33% from 2015.

Cause	Age-standardised death rates per 100 000 population, 1990 to 2021 for mechanism of injury			Age-standardised DALY rates per 100 000 population, 1990 to 2021 for mechanism of injury		
	1990	2021	% Change	1990	2021	% Change
Transport injuries	25.96	27.99	8%	1220.89	1299.87	0.06
Road injuries	25.00	26.42	6%	1166.01	1212.09	0.04
Pedestrian road injuries	16.94	10.29	-39%	737.82	426.13	-0.42
Cyclist road injuries	0.09	1.13	1188%	9.69	50.69	4.23
Motorcyclist road injuries	0.22	0.31	37%	20.57	21.18	0.03
Motor vehicle road injuries	7.08	13.55	91%	366.40	661.15	0.80
Other road injuries	0.66	1.14	72%	31.52	52.93	0.68
Other transport injuries	0.97	1.57	62%	54.89	87.78	0.60
Unintentional injuries	27.93	35.28	26%	1424.63	1848.53	0.30
Falls	6.62	6.52	-2%	261.33	272.43	0.04
Drowning	4.08	5.71	40%	233.43	338.26	0.45
Fire, heat, and hot substances	5.08	7.51	48%	268.19	391.75	0.46
Poisonings	2.78	3.49	26%	146.94	187.36	0.28
Poisoning by carbon monoxide	0.36	0.49	38%	23.48	30.84	0.31
Poisoning by other means	2.42	3.00	24%	123.46	156.52	0.27
Exposure to mechanical forces	1.48	2.15	45%	117.96	150.91	0.28
Unintentional firearm injuries	0.22	0.36	63%	13.57	20.86	0.54
Other exposure to mechanical forces	1.26	1.79	42%	104.39	130.05	0.25
Adverse effects of medical treatment	1.92	2.12	11%	67.04	78.04	0.16
Animal contact	1.97	2.77	40%	85.28	126.13	0.48
Venomous animal contact	1.21	1.67	38%	47.92	70.49	0.47
Non-venomous animal contact	0.76	1.10	45%	37.36	55.64	0.49
Foreign body	1.61	2.46	53%	99.02	142.44	0.44
Pulmonary aspiration and foreign body in airway	1.58	2.42	53%	79.88	125.39	0.57
Foreign body in eyes	0.00	0.00	0.00	2.31	2.28	-0.01
Foreign body in other body part	0.03	0.05	45%	16.84	14.77	-0.12
Environmental heat and cold exposure	0.27	0.33	23%	15.67	18.20	0.16
Exposure to forces of nature	0.00	0.02	Infinite increase	0.00	3.38	Infinite increase
Other unintentional injuries	2.12	2.20	4%	129.78	139.61	0.08
Self-harm and interpersonal violence	22.31	34.52	55%	1111.88	1774.24	0.60
Self-harm	14.56	23.79	63%	591.38	1063.60	0.80
Self-harm by firearm	0.61	0.86	41%	24.02	37.58	0.56
Self-harm by other specified means	13.95	22.92	64%	567.36	1026.02	0.81
Interpersonal violence	7.51	10.64	42%	504.78	701.51	0.39
Physical violence by firearm	0.61	0.94	55%	35.35	55.57	0.57
Physical violence by sharp object	1.67	2.58	55%	108.85	165.20	0.52
Sexual violence	0.00	0.00	0.00	36.92	37.10	0.00
Physical violence by other means	5.24	7.12	36%	323.66	443.64	0.37
Conflict and terrorism	0.23	0.02	-90%	15.64	4.10	-0.74
Police conflict and executions	0.00	0.07	4062%	0.07	5.03	67.00

Figure 8. Heatmap of level 4 injury age-standardised deaths rates and DALY rates with percentage change 1990-2021 by cause, all ages in Zimbabwe.

Injury deaths by sex and age

In 2021 the injury death rate in males (151.48 deaths per 100 000 population, 95% UI: 118.44 to 190.44) was almost three times higher (2.87 times) than that for females (52.83, 95% UI: 40.50 to 67.14). This difference persisted throughout the period from 1990 to 2021. Stratification of injury deaths by cause revealed that this sex difference was consistent across injury types and across all ages except for falls in the >80 age group.

(Figure 9)

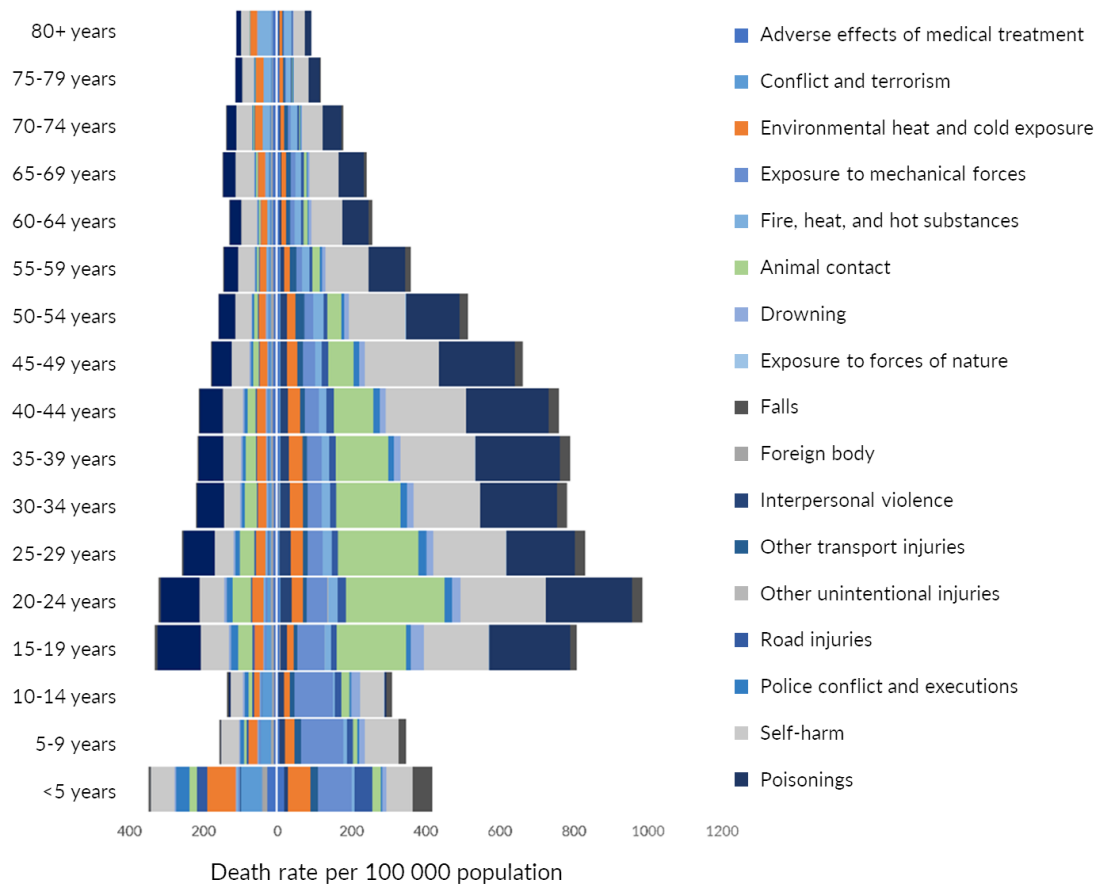


Figure 9. injury death rates per 100 000 population by age and level 3 cause of injury death and sex in Zimbabwe in 2021

Almost one third (35.4%) of all deaths due to injuries occurred among ages under 24 years. The number of injury deaths was highest among the 15 to 19 and 20 to 24 years age groups. Injury burden varies predictably across the life course. Foreign bodies are most common injury in the <1 age group, fire, heat and hot substances are most common in the 1-4 years age group. interpersonal violence emerges as a major cause of death from the 15 years of age. Falls become increasingly common with advancing age and road traffic injuries persist across the life-course.

National overview of injury DALYs, YLL and YLD.

The age-standardized DALY rate for injury per 100,000 population in Zimbabwe increased by 31% from 3757.2 (95% UI, 3214.4 - 4,334.6) in 1990 to 4,921.4 (95% UI, 3,914.5 - 6,026.8) in 2021. Injuries constituted 7.25% of all-cause DALYs in 2021 (95% UI, 6.28% to 8.26%). The injury age-standardized DALY rate for male sex was 2.9 times higher than for females in 2021 and men had a 33.8% increase from 1990 compared to a 33.1% increase for women in the same time period. The age-standardised DALY rate for each cause of injury is shown in figure 3. By level 3 injury cause, road injuries caused the highest age-standardised DALY rate in 2021 (1094.3 per 100,000 persons) followed by Self harm, interpersonal violence, drowning and falls in 2021 (Figure 8). The YLL and the YLD for each cause are shown in Figure 10.

Cause	Age-Standardized YLL Rate (95% UI), per 100,000 persons			Age-Standardized YLD Rate (95% UI), per 100,000 persons		
	1990	2021	% Change	1990	2021	% Change
Transport injuries	1109.63	1211.15	9%	110.86	88.92	-20%
Road injuries	1062.25	1131.24	6%	103.38	81.09	-22%
Pedestrian road injuries	689.49	404.65	-41%	48.17	21.85	-55%
Cyclist road injuries	3.88	43.26	1015%	5.81	7.35	26%
Motorcyclist road injuries	12.18	16.33	34%	8.38	4.92	-41%
Motor vehicle road injuries	330.65	620.59	88%	35.50	40.41	14%
Other road injuries	26.05	46.40	78%	5.51	6.55	19%
Other transport injuries	47.38	79.91	69%	7.48	7.82	5%
Unintentional injuries	1129.53	1565.42	39%	295.17	283.32	-4%
Falls	155.71	172.76	11%	105.58	99.81	-5%
Drowning	231.09	335.99	45%	2.21	2.08	-6%
Fire, heat, and hot substances	196.67	314.86	60%	71.70	76.77	7%
Poisonings	143.42	184.49	29%	3.51	3.03	-14%
Poisoning by carbon monoxide	22.61	30.16	33%	0.85	0.72	-15%
Poisoning by other means	120.81	154.33	28%	2.66	2.31	-13%
Exposure to mechanical forces	71.34	109.61	54%	46.64	41.26	-12%
Unintentional firearm injuries	10.65	18.38	73%	2.92	2.51	-14%
Other exposure to mechanical forces	60.69	91.23	50%	43.72	38.75	-11%
Adverse effects of medical treatment	66.03	76.97	17%	1.00	0.99	-1%
Animal contact	78.24	118.69	52%	7.04	7.50	7%
Venomous animal contact	46.59	68.96	48%	1.33	1.58	19%
Non-venomous animal contact	31.65	49.74	57%	5.71	5.91	4%
Foreign body	80.19	126.74	58%	18.81	15.76	-16%
Pulmonary aspiration and foreign body in a	78.35	123.99	58%	1.51	1.47	-3%
Foreign body in eyes	-	-	-	2.31	2.28	-1%
Foreign body in other body part	1.84	2.75	50%	14.99	12.01	-20%
Environmental heat and cold exposure	10.30	14.09	37%	5.39	4.24	-21%
Exposure to forces of nature	0.00	1.14	1144375758%	0.00	2.24	#DIV/0!
Other unintentional injuries	96.55	110.07	14%	33.29	29.65	-11%
Self-harm and interpersonal violence	996.06	1651.83	66%	116.14	121.37	5%
Self-harm	578.05	1044.95	81%	13.25	17.24	30%
Self-harm by firearm	23.80	37.34	57%	0.19	0.20	4%
Self-harm by other specified means	554.25	1007.61	82%	13.06	17.04	30%
Interpersonal violence	405.03	601.16	48%	99.69	100.43	1%
Physical violence by firearm	33.59	54.12	61%	1.77	1.57	-11%
Physical violence by sharp object	94.25	151.25	60%	14.55	14.11	-3%
Sexual violence	-	-	-	36.92	37.10	0%
Physical violence by other means	277.20	395.79	43%	46.46	47.65	3%
Conflict and terrorism	12.92	1.47	-89%	3.18	2.96	-7%
Police conflict and executions	0.07	4.24	6271%	0.01	0.74	5811%

Figure 10. Heatmap of level 4 injury age-standardised years of life lost due to premature mortality (YLLs) and years of healthy life lost due to disability (YLDs) with percentage change 1990-2021 by cause, all ages in Zimbabwe.

Injuries and planetary health

Deaths from exposure to forces of nature increased substantially between 1990 and 2021 from 0.00 per 100 000 to 0.02 per 100 000 population, the most significant increase of any injury cause, while deaths from 'environmental heat and cold exposure' increased by 24% in the same period. The trend of age-standardised death rates and DALYs over that time is shown in Figure 11.

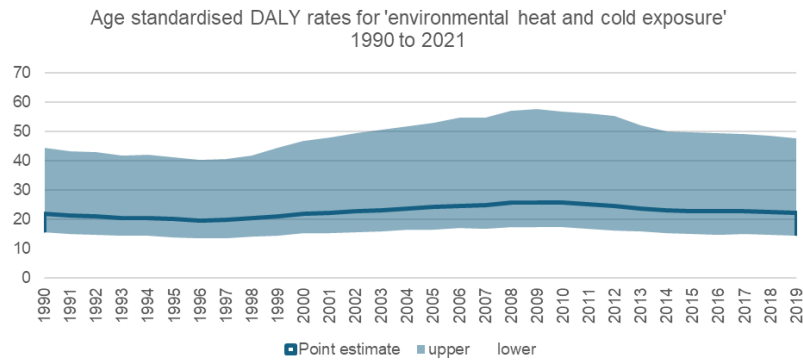
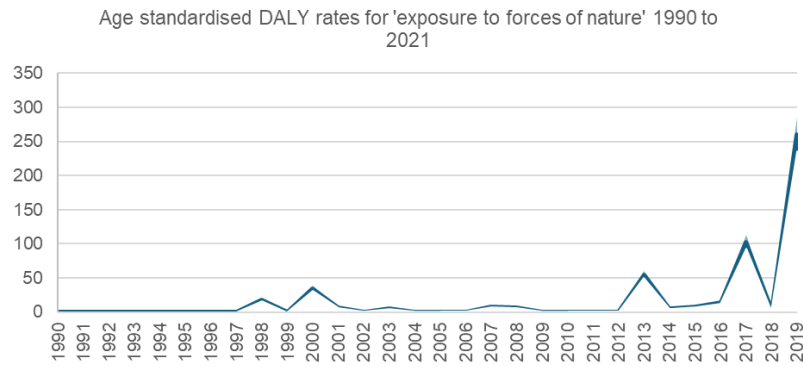
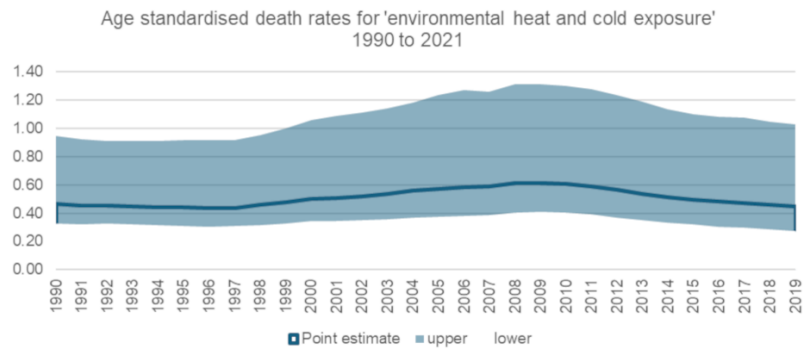
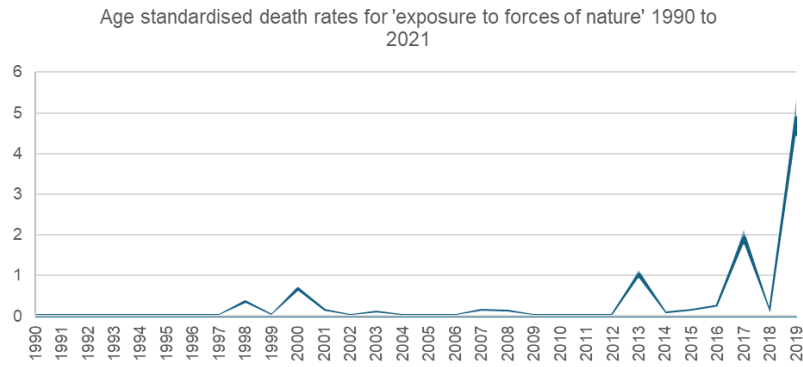


Figure 11. Trends in age-standardised death rates (A, B) and DALY rates (C, D) from 'exposure to forces of nature' and 'environmental heat and cold exposure' from 1990 to 2021 in Zimbabwe.

2.5 Discussion

Injuries are an increasingly important public health problem in Zimbabwe. Accurate data on disease burden is crucial to inform priority setting, policy formulation, design of interventions and further research. In this analysis, we present patterns and trends regarding the burden of injuries in Zimbabwe. In summary, we found that Injuries continue to constitute a large and growing percentage of deaths and DALYS lost in the country, as those due to major communicable diseases decline. This trend is mirrored globally (1) on the continent (41) and also in other LMICs where non-communicable diseases and injuries are rising (42). This emerging burden of injury in the country has been relatively neglected historically in the face of the considerable burden of communicable diseases, particularly related to HIV/AIDS, in the last decade. However, it is increasingly being recognised in the national health priorities (43) as well as the national surgical obstetric and anaesthesia strategy (NSOAS) (44). Road injuries and unintentional injuries are significant causes of injury in the country, and self-harm, interpersonal injury, and falls are also increasing. The lower percentage of all-cause mortality attributable to injury in Zimbabwe (6.01%) relative to globally (7.6%) may be explained by the fact that injury surveillance has lower coverage than the global average so while it seems that Zimbabwe is doing better than globally, the country is in fact undercounting injuries relative to other conditions. Progress on unintentional injury is falling behind road injuries, perhaps reflecting increased attention on road injuries at the expense of other injuries. Injury deaths purportedly make up 6.01% of all-cause mortality vs the global 7.6%, which suggests that injuries are less of an issue in Zimbabwe than the global average. However, as outlined earlier, this proportion is potentially an underestimate because data collection and coverage are comparatively better for other causes relative to injuries. This would lead to injuries being undercounted while

infectious diseases such as HIV, tuberculosis and Malaria are at near complete data coverage. There is precedent for this in other countries. (20) (37) (38)

Falls are a particular burden in the country and have increased by 11% since 1990; however, they don't appear frequently in published and unpublished literature on trauma admissions in Zimbabwean hospitals. This may be because of the general lack of published data from Zimbabwe or because fall deaths are not being captured in current data collection systems. Falls tend to occur in the context of household incidents or as occupational injuries in artisanal and small-scale gold mines and thus may be prone to underreporting.

Injury in children in Zimbabwe

Children and adolescents continue to be particularly vulnerable to injury. The 15 to 24 year age group (adolescents) is the age group with the highest death rate for injury in the country, mirroring the situation in other countries (45,46). The national mortality profiles from the government which are part of the underlying data for these estimates do not provide enough granularity to disaggregate different childhood and adolescent age groups. The mortality reports only use two age groupings: less than 5 years and greater than 5 years. This leads to significant uncertainty when deaths are split into respective GBD age groups using the age-sex splitting tool. Predominant causes of injury deaths in each age group demonstrate the change in injury risk along the life-course and emphasise the need for targeted interventions for each age group based on this risk.

Limitations of estimates

Modelled estimates of injury are never perfect, and some have multiple areas of uncertainty inherent to them. The first source of uncertainty in the modelled estimates is the availability and accuracy of underlying source data and of data concerning covariates

used for modelling estimates. The sources of primary data used for the GBD-2021 estimates for Zimbabwe are derived from police and crime reports as well as vital registration data (supplementary table 1). Underreporting from both these two sources have long been recognised as a source of uncertainty in local statistics and this is particularly true for Zimbabwe (47) (48). Zimbabwe's vital registration system appears to have poor coverage and performs poorly compared to other countries in the region and globally when assessed using the vital statistics performance index (VSPI) (49). VR completeness in Zimbabwe was reported at 48.7% in 2019, and appears to have been decreasing over the years (50) while death registration completeness in Zimbabwe is thought to be between 32.95% and 41.4%. (22) VR completeness has a major effect on accuracy of mortality models and in GBD-2021 those data from countries with completeness less than 50% were eliminated and not used for model estimation. GBD assigns a simple star-rating system from 0 to 5 to assess the quality of VR/VA data available in a given country. Zimbabwe has a two out of five-star rating denoting poor quality. With regard to police data for road traffic deaths, police data has been critiqued because of the lack of a unified national definition of a traffic accident death (17). In Zimbabwe police statistics do not report deaths that occur after hospital transfer by law enforcement and up to 30-days after the injury as is the standard. Therefore, reported police mortality data has to be adjusted for expected underreporting in the figures using the European Conference of Ministers of Transport (ECMT) standardised 30-day road crash adjustment factors. (51) These adjusted figures, however may differ from the true number of additional deaths that may occur during the rest of the 30-day period due to issues specific to the Zimbabwean health care system (8). Verbal autopsy data is plagued with difficulties (52) and lastly the national health profiles were last published in 2014 and have not contributed to GBD estimates since then (53), accounting for the widening confidence

interval for estimates. The country does not currently have a trauma registry whether national, regional or facility-based and large-scale surveys such as the census and demographic health survey do not collect sufficient data useful to inform injury mortality estimates. Improved surveillance is an important first step to tackling this growing burden of disease and would vastly improve health estimates for injury. Data is also needed to support subnational analysis of injury epidemiology as well as analysis across the different tiers of the health system and sociodemographic groups. Facility-based surveillance is also best placed to continue follow up till the 30-day mark. Zimbabwe has relatively low availability and quality of nationally representative data for estimation of injury burden (37).

Uncertainty intervals may give some indication of where the underlying primary data sources need to be strengthened. While UIs should include all sources of uncertainty, including those arising from measurement error, systematic biases, modelling and extrapolation to compensate for incomplete data; the uncertainty intervals reported in GBD generally reflect the variation observed in sample data.

Injury and planetary health in Zimbabwe.

Injuries caused by ‘exposure to forces of nature’ experienced a substantial increase from virtually zero deaths in 1990 to a rate of 0.02 deaths per 100 000 in 2021. Further analysis shows that spikes in deaths from forces of nature are intermittent but occurring at an increasing frequency during the period culminating in a sharp increase in 2019. This coincides with the arrival of Cyclone Idai in March of 2019 in the region. This was one of the worst tropical cyclones on record to affect the Southern Hemisphere that devastated parts of Zimbabwe, Mozambique and neighbouring countries. The health system was ill-prepared to respond to the emergency (54) and estimates for the human cost vary widely. An exact number of those affected is difficult to obtain. This was not reflected, however, in

the confidence intervals of GBD data. Rankings of causes of death and DALYs in 2019 were affected by the occurrence of Cyclone Idai and should be read in that context. The event may have over-emphasised the ranking of ‘exposure to forces of nature’ relative to other causes for that year. However, notwithstanding the rarity of such large storms, tropical cyclone landfalls from the Indian Ocean are expected to increase in frequency in the future (55). Mozambique and Zimbabwe achieved the ignominious distinction of being number one and two on the Global Climate Risk Index 2021 that year partly as a result of that event up from a rank of 54 and 132 (56). The rate of injury deaths and DALYs due to environmental heat and cold exposure has also increased less dramatically over the period 1990 to 2021, however there are wide confidence intervals associated with this data. There is an increasing realisation of the contribution of climate change to disease and injury burden in Zimbabwe and this deserves more attention. The trauma system is a central component of national disaster preparedness and the clinical, humanitarian, and logistical response to these events should be incorporated into any national strategy for trauma prevention and care. Disaster preparedness and response has previously been referred to only in the context of outbreaks of diarrheal infectious diseases, however the experience of Cyclone Idai has underscored the need for integrating emergency and injury care and surgical systems planning in disaster preparedness.

2.6 Recommendations

- 1 Hospital-based, regional and national data systems should be established to feed into estimates and provide crucial information for targeted health policy making for injury.
- 3 Revival of annual national mortality reports with adequate age, sex and cause disaggregation.

- 4 A standalone National Injury Mortality Survey (NIMS) should be commissioned to understand subnational cause and age-specific mortality for injury similar to examples in other southern African countries (57) (58).
- 5 Advocate for making the Demographic and Health Survey accident and injury module a mandatory DHS module while updating the survey to reflect best practices in injury survey design.

CHAPTER 3: Evaluating Trauma Registry Literature in Africa: A Scoping Review of Methodology, Tools, Reporting Quality and the Inclusion of Children.

3.1 Background

Trauma surveillance is a key first step in addressing the injury burden. Our previous work established that there is minimal available published data on injury burden in Zimbabwe, and a trauma registry data was not found.

With the backdrop of the considerable development and consolidation of registries occurring worldwide, African countries are in danger of being left behind with resultant widening in disparities in trauma system development and, ultimately, outcome. There is an urgent need to take stock of developments in trauma registries in Africa and understand the size of the gap, degree of fragmentation, and opportunities for harmonisation of registries in Africa.

The WHO minimum dataset for injury defines a minimum set of variables in trauma registries, but the adoption and use of this tool is unknown. In addition, the tool was not developed with children in mind, which may have hindered the inclusion of children in surveillance. Child-specific variables, outcomes and design is crucial in the African region where almost half the population are children. The exclusion of children in trauma literature has been a persistent problem since the first trauma registries (59).

The purpose of this review is to understand the state of trauma registries in Africa since the publication of the WHO injury surveillance guidelines, to assess their adoption, to compare the variables reported against trauma data standards of mature registries from high income countries, to assess the inclusion of children in registry literature, and to

assess reporting quality and the case for the establishment of reporting guidelines for uniform reporting of trauma registries in LMICs. This study will provide a framework which allows for context-aware decision-making for registry development.

3.2 Chapter Objectives and study research questions

Objectives:

1. To systematically review the trauma registry literature in Africa since the adoption of WHO injury surveillance guidelines, highlighting trends, geography, methodological, administrative, and quality issues.
2. Determine the extent to which children are included in trauma registry literature across Africa, and age definitions to identify gaps in paediatric data collection.
3. To compare the variables and outcomes reported in African trauma registries with those in established international trauma databases and standards including the WHO minimum dataset for injury, to identify discrepancies and areas for standardization.
4. To identify variables from available African trauma registries for use in a new trauma registry.

Review questions.

1. What is the extent, distribution and trends in available literature derived from trauma registries in Africa from 2000 to 2023?
2. How do the methodologies, inclusion criteria and variables collected, in African trauma registry literature compare

- a. What is the number and nature of variables collected in African trauma registry literature and how do they compare to standard datasets for international registries and the WHO minimum dataset for injury.
3. What is the nature and extent of inclusion of children in trauma registry literature in Africa?

3.3 Methods

The proposed review was conducted in accordance with the JBI methodology for scoping reviews. We utilised a scoping review methodology that was developed a priori based on the method of the Joanna Briggs Institute for scoping reviews and following the JBI SUMARI template. Our review protocol was previously published on PROSPERO (CRD42024529859). We searched the peer-reviewed published literature and grey literature for all sources reporting data from trauma registries relating to injury sustained on the African continent.

3.3.1 Data sources and search strategy

To identify studies pertaining to trauma registry data, we developed a search strategy based on the concepts of injury, registry/database/databank, and Africa. We searched MEDLINE, EMBASE, global health databases, Open Access Dissertations and Theses database, and preprint servers from 2000 to January 2023. In addition, we also hand-searched the reference lists of the eligible studies to identify additional relevant sources. Before stating that a country had no registry, we performed additional intensive, focused searches in countries that appeared to have no literature from the search, including searching for explicit statements that the country had no trauma registry in identified sources.

3.3.2 *Citation management*

Following the search, all references were collated and imported into EndNote © version 20 (Clarivate Analytics, Philadelphia) for removal of duplicates and then uploaded to Rayyan online software (<https://rayyan.qcri.org/>) (60).

3.3.3 *Study selection and data abstraction.*

The title and abstract of each citation identified was independently screened for eligibility by two reviewers with disagreements resolved by an independent third reviewer. To be eligible for inclusion the source had to (1) use data from a prospectively maintained database or registry, (2) be published after the year 2000, (3) include injury victims in Africa as the population of interest. Studies were excluded if they (1) relied on retrospectively collected routine hospital data, (2) if the data collection period was before 2000 even if published after, (3) were hospital based, household or school-based surveys or if full texts were not available (appendix 4). Screening was undertaken against the inclusion criteria after a pilot screening process showed greater than 75% agreement. Full text screening was performed by four independent reviewers and disagreements were resolved by a fifth independent reviewer.

3.3.4 *Eligibility criteria*

Participants

This review focuses on studies concerning people of any age who have been injured.

Concept

Any literature reporting results from data stored in or prospectively collected for a trauma registry, database, or databank will be included in the review.

Context

Any literature pertaining to injury sustained on the African continent published from 2000 to 2023.

3.3.5 Types of Sources

This scoping review will consider any descriptive observational study designs, including case series and descriptive cross-sectional studies. In addition, analytical observational studies, including prospective cohort studies, case-control studies and analytical cross-sectional studies, will be considered for inclusion. Grey literature will be included, including registry reports, official statistics and commissioned reports of government departments and nongovernmental organisations, and preprints. Reviews, viewpoints, case reports, commentaries, letters and conference proceedings will be excluded from the review. No language restrictions will be applied.

Table 2. Inclusion and exclusion criteria

	Include	Exclude
Publication type	Peer reviewed journals Grey literature Descriptive and analytical observational studies Case series.	Case reports Systematic reviews (reference lists searched) Commentaries Letters Qualitative studies
Population	Any age Male and Female	Not applicable
Concept	Trauma registry/database/databank Injury <ul style="list-style-type: none">• Unintentional injury• Intentional injury• Transport injury<ul style="list-style-type: none">○ Road injury	Birth injury Adverse effects of treatment Poisoning
Context	Injury sustained in an African country from 2000 to 2023	Studies on African migrants injured abroad

Outcome	At least one methodological outcome related to data collection, storage, follow-up and coverage.	
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Definitions

For the purposes of this review and the rest of this thesis, injury refers to ‘damage to body tissues caused by an acute transfer of energy (mechanical, thermal, electrical, chemical) or by the sudden absence of heat,’ that is in excess of physiological tolerance thresholds. It occurs at the point of the incident and the scene. It is assessed through trauma surveillance systems (trauma registries), hospital records, and population surveys that attempt to identify risk factors, patterns and preventive measures. This thesis subclassifies it into transport injury, unintentional injury, and intentional injury to align with that used by the Global Burden of Disease study (WHO/IHME). “Transport injury” refers to injuries resulting from incidents involving motor vehicles and other forms of transportation (“road injury” is a subcategory of this), unintentional injury refers to that subset of injuries for which there is no evidence of intent to cause harm; Intentional injury as per the World Health Organisation refers to “The intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation.” The word ‘trauma’ is sometimes used synonymously with ‘injury’, but has a different meaning. Trauma refers to the body’s complex physiological and psychological response to injury. Trauma is assessed through anatomical or physiological observations that may be operationalised through scoring systems such as the “injury severity score (ISS) or “Kampala trauma score” (KTS). The word trauma is

used with other terms such as ‘trauma registry’ and this is used as a compound term in this thesis according to the following definition. A trauma registry is defined as “a dedicated injury database, prospectively collecting information regarding injured patients at one or more health facilities”. The word ‘trauma’ should not be confused with the alternative meaning of ‘psychological trauma’, which may denote an emotional and cognitive response to threatening or harmful experiences. This alternative meaning is not used in this review or this thesis.

Data extraction

Data was extracted by four independent reviewers using a purpose-built spreadsheet tool on Microsoft excel 2017 (appendix 4). The data extracted from each article included a variety of administrative, operational, variable and outcome information pertaining to the registries as well as methodological information, data quality and quality of reporting. The tool used elements modified from multiple sources including the “trauma registry assessment tool”, (61) the “Helsinki trauma registry audit tool”, (62) the “Evaluation Framework for Injury Surveillance Systems” (EFISS) (63) as well as other bespoke elements. Reporting quality of included studies was assessed using the STROBE checklist; however, no studies were excluded for quality reasons. Registry facility level was determined with reference to the African database of public service providers, a publicly available list of facilities. (64) Coverage of trauma registries was defined as institutional (single and multicentre), regional, national and multinational. For phase of care, we used a modification of the 4-tier model of trauma registry involvement in LMICs developed by Pyda et al: (emergency department (ED) only, ED with prehospital data, ED with in-hospital data, and ED with pre-hospital, in-hospital, and post-discharge). (65) For each trauma registry and source, we determined whether a data dictionary was available using available published information and then looked for implied definitions of variables from

the text based on apparent intent and options. Then we compared each variable with various references and categorised them as YES (reported with the same definition), PARTIAL (reported but with a different definition) or NO (not reported). Collection was further categorised as concurrent or retrospective data collection, and data collectors were categorised as attending (or non-attending) health care workers, attending (or non-attending) non-clinical workers, trauma-trained registrars, health information specialists or health care workers as modified from Nwomeh et al. (66)

3.3.6 Data analysis

A comprehensive list of all variables/items reported in the identified literature was prepared. Each was made into a data point/variable defined as “an unambiguous term without possible misinterpretation” as per Ringdal et al. (67) Identified data points were compared with those of the WHOISG. Variables were categorised as: demographic information, initial clinical condition, details of injury, prehospital facility care, injury exam, emergency unit details, inpatient details, and outcomes according to categories from the WHO dataset for injury verbatim. The frequency with which each item was included in each study literature was calculated, and we created frequency distributions for variables across all tools. Those items that were part of the WHO minimum dataset for injury and those that appeared with a threshold minimum frequency were collated into a long list of recommended items.

3.4 Results

The initial search identified 3307 studies. After screening 2640 titles and abstracts, 2292 abstracts were excluded as duplicates or irrelevant. 348 full text citations were assessed for eligibility, 36 were excluded with reasons, and 7 were added from other search methods. In total, 319 studies were included (**Figure 12**).

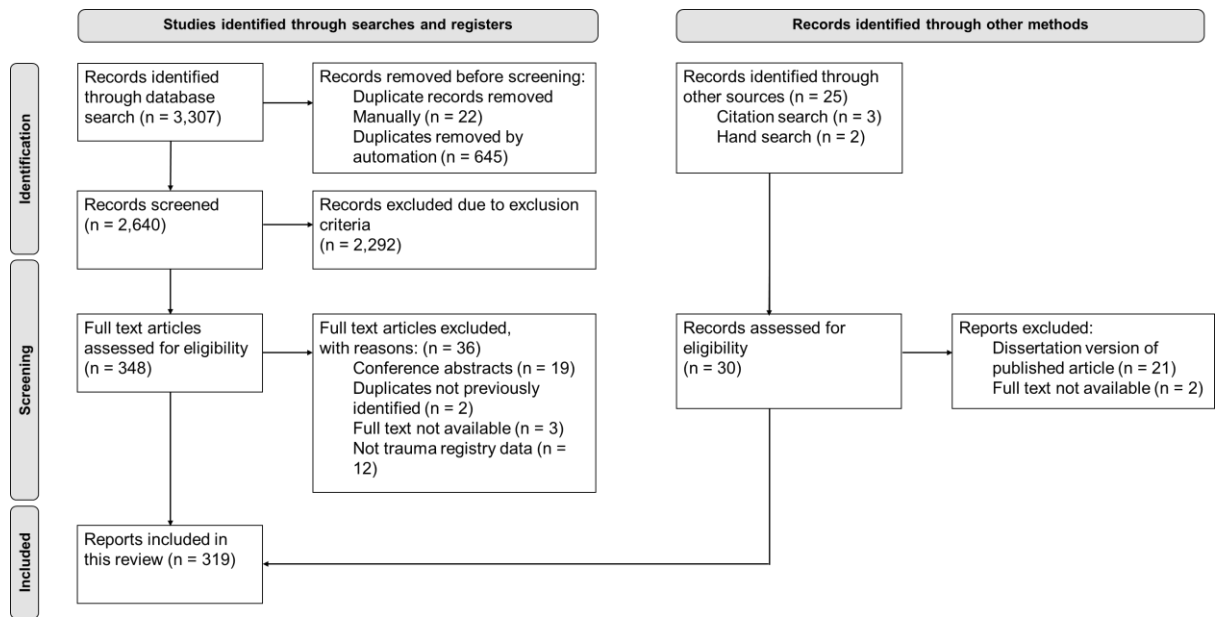


Figure 12. PRISMA diagram for scoping review of trauma registry literature.

Temporal and geographic trends in trauma registry literature

Trauma registry literature increased substantially from 2010 onwards and 2016 and has remained at a rate of 27 to 43 sources annually (**Figure 13**)

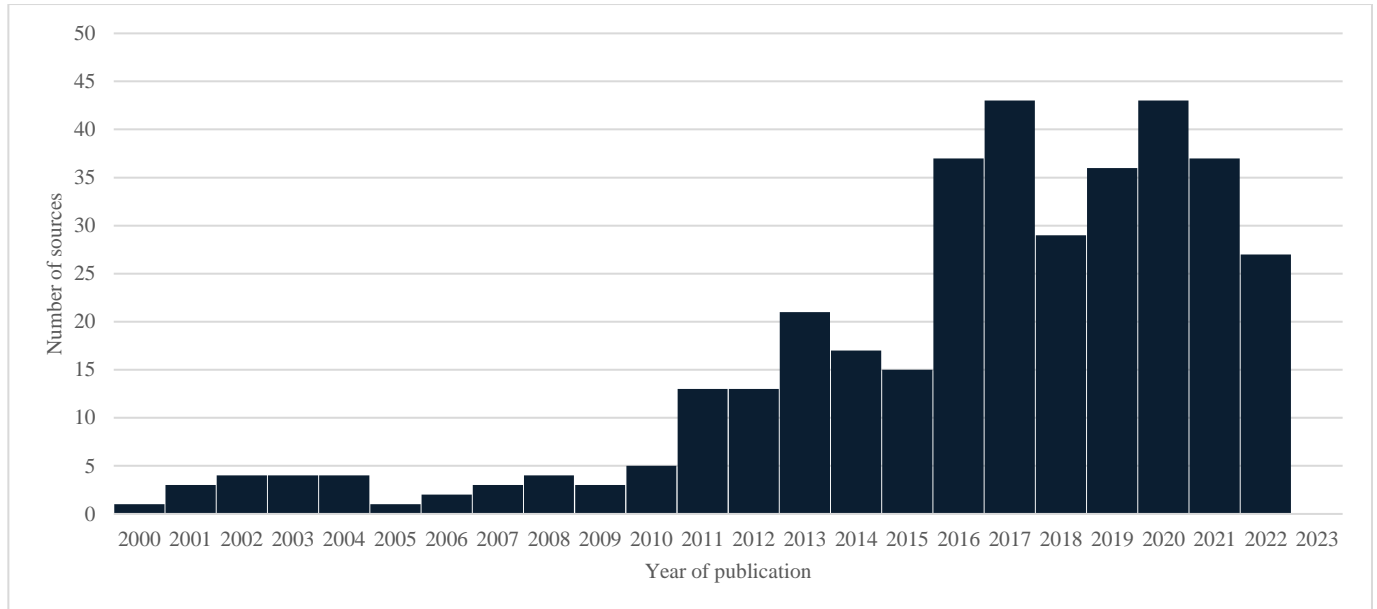


Figure 13. Number of literature sources per year that report trauma registry data in an African country.

Most identified literature was from central and southern African countries and was dominated by sources from a handful of countries **Figure 14**. South Africa, Malawi,

Nigeria, Tanzania and Uganda were the top five countries with the most literature sources identified. Twenty-two African countries were the source of trauma registry literature, while no literature was identified in the remaining 32 countries.

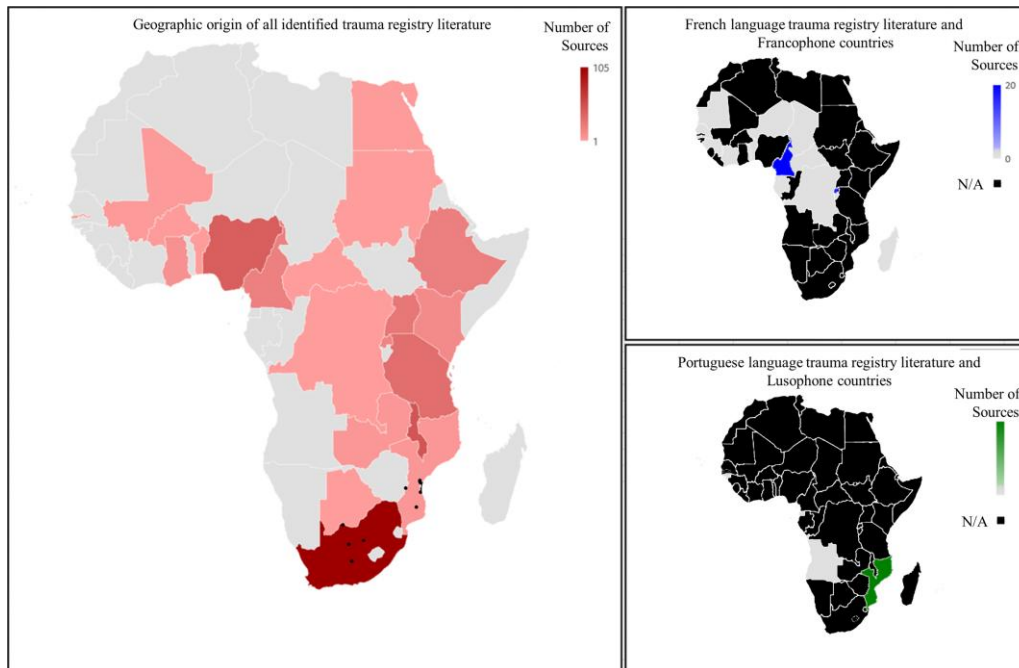


Figure 14a. Geographic distribution of identified trauma registry literature across the Africa between 2000 and 2023. **11b.** French language trauma registry literature, **11c.** Portuguese language trauma registries.

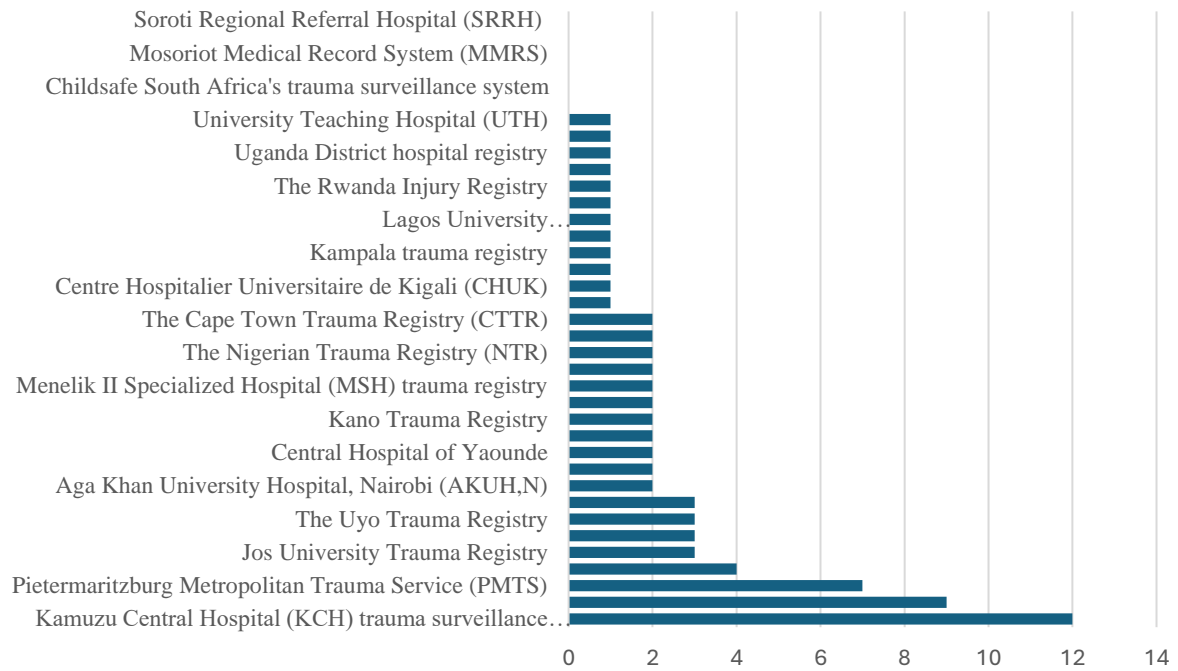


Figure 15. Frequency of sources reporting on or using data from a trauma registry in Africa.

Phase of care of trauma registries

The most frequently reported phase of care in trauma registries was in the emergency room (100%) and prehospital care. There was a demonstrable gap in collected information from the admission and operative phases of care and thereafter in the rehabilitative phase.

Table 3. Population characteristics of registries in identified sources and reports.

Characteristics	Frequency (%)
<i>Population coverage</i>	
Institutional	285 (99.3%)
• Single	240 (84.2%)
• Multicentre	45 (15.8%)
Regional	2 (0.7%)
Population-based	0 (0.0%)
<i>Health system level</i>	
Quaternary + Tertiary (higher level)	250 (87.1%)
Secondary	37 (12.9%)
Primary	1 (0.3%)
Mixed	16 (5.6%)

<i>Geography</i>	
Urban	249 (86.8%)
Rural	4 (1.4%)
Mixed	34 (11.8%)
<i>Facility ownership</i>	
Public	238 (82.9%)
Private	2 (0.7%)
NGO	16 (5.6%)
Mission	28 (9.8%)
Military	3 (1.0%)

Table 4. design characteristics of identified trauma registry literature

Characteristics	Frequency (%)
Paper-based	117 (40.8%)
Electronic	19 (6.6%)
Hybrid	15 (5.3%)
Not reported	136 (47.4%)
Number of Pages	
1	29 (10.3%)
2	11 (3.8%)
>2	4 (1.3%)
Not reported	239 (83.3%)
Number of variables	
1 to 20	8 (2.8%)
20 to 40	27 (9.4%)
>40	9 (3.1)
Not reported	243 (84.7%)

Data collection

Trauma registry was most commonly collected by the attending clinician in 29% of sources identified. However, poor reporting of this aspect of data collection was evident.

Table 5. Data collection characteristics of identified trauma registry literature

Data collection consideration	Number of sources (percentage)
<i>Data collector</i>	
<i>Healthcare workers (clinical)</i>	
Attending clinical	84 (29.3%)
Non-attending clinical	4 (1.4%)
<i>Healthcare workers (non-clinical)</i>	
Attending non-clinical	8 (2.9%)
Non-attending, non-clinical	31 (10.8%)
Trauma trained registrars	0 (0%)
Health information specialist	0 (0%)
Mixed clinical and non-clinical	8 (2.9%)
Not reported	152 (52.9%)
<i>Timing of collection</i>	
During the clinical encounter	38 (13.2%)
After the clinical encounter	12 (4.2%)
Not reported	237 (82.6%)

Variables identified

A total of 189 unique variables/datapoints were identified from the identified literature (Figure 16). These were distributed across the trauma registry domains as shown in table 6.

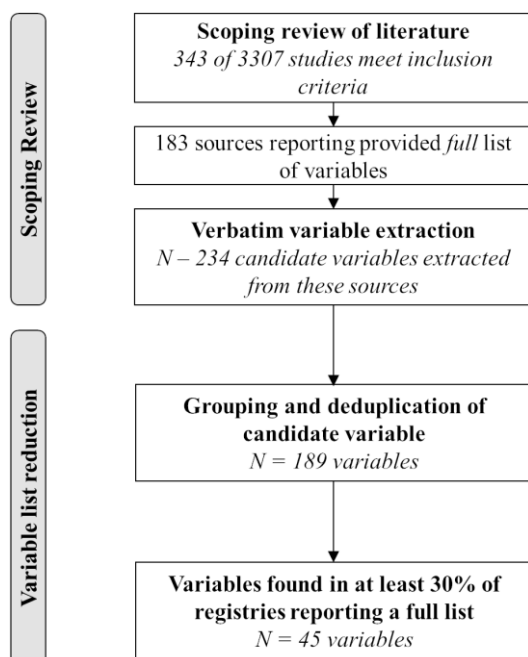


Figure 16. identification, filtering and categorisation of trauma registry variables.

Table 6. variables used in trauma registry literature. (29) those found in more than a threshold of 30% of registries are shown in this table.

Variable category	Variable	Number of Registries	Percentage of Registries
Patient Registration	Facility ID	144	50%
	Registry Case ID	161	56%
	Date of Birth	89	31%
	Age	215	75%
	Gender	253	88%
	Patient Residence	161	56%
Patient Details	Patient Occupation	126	44%
Initial Clinical Condition	Arrival Date	232	81%
	Arrival Time	215	75%
	Emergency Unit/Facility Arrival Mode	198	69%
	Initial Heart Rate	215	75%
	Initial SBP	215	75%
	Initial Spontaneous Respiratory Rate	215	75%
	Initial Oxygen Saturation	126	44%
	Supplemental Oxygen Administration	89	31%
	Initial GCS - Total	215	75%
	Initial GCS - Eye	100	35%
	Initial GCS - Verbal	100	35%
	Initial GCS - Motor	100	35%
	Initial AVPU	144	50%
	Time of First Provider Assessment	89	31%
	Is patient pregnant?	80	28%
Details of Injury	Injury Geographic Location	126	44%
	Injury Event Date	215	75%
	Injury Event Time	198	69%
	Setting	126	44%
	Mechanism	232	81%
	IF RTI Patient Mode of Transport	161	56%
	--> Road User	181	63%
	Intent	161	56%
	Protective Devices	89	31%
	Alcohol Use	126	44%
	Drug Use	89	31%
		Injury Anatomic Location	106
Emergency Unit Details	Emergency Unit Interventions	89	31%
	Emergency Unit Departure Date	123	43%
	Emergency Unit Departure Time	112	39%
	Emergency Unit Disposition	106	37%
	IF Morgue or Died --> Official Cause of Death	86	30%
	Standardised Diagnosis	181	63%
	Facility Discharge Date	89	31%

Outcome details	Facility Disposition	109	38%
	Standardised Diagnosis	106	37%
	Final disposition	201	70%

Table 7. Inclusion criteria used in trauma registry literature. (Some registries have multiple inclusion criteria.)

Criteria type	Number of sources
<i>Severity of injury</i>	
Combined Anatomical and Physiological Scoring Systems	8
Simple anatomical proxy	2
<i>Type and Location of Treatment</i>	
Emergency Department (ED) Treatment	25
Admitted to wards	20
<i>Nature of Injury or Event</i>	
Specific Injuries or Procedures	34
“Major trauma” based on clinical judgment	19
Time-based (e.g. within 24 hours of injury)	57

Table 8. Inclusion of children in trauma registries.

Extracted item	Result
<i>Children Included</i>	
Yes	79 (27.5%)
No	108 (37.6%)
Not Reported	100 (34.8%)
<i>Age definition</i>	
Modal age	15 years
Not reported	43 (54.4%)

Inclusion of variables aimed at measuring socioeconomic status are inconsistently included and sparse. The frequency of reporting of variables related to socioeconomic status are shown in table 9.

Table 9. Variables used as proxies for socioeconomic status in identified trauma registry literature.

Variable	Reporting frequency (%)
Occupation	45 (15.7 %)
Level of education	12 (4.2 %)
Residential Address	30 (10.5 %)
Insurance status	19 (6.2 %)
Payment mode for Care	7 (2.4 %)

3.5 Discussion

This scoping review provides an in-depth overview of the extant literature concerning trauma registry literature in Africa in the last 23 years, highlighting trends, methodological patterns and variables used. Trauma registries have been proliferating across the continent since 2000. There are, however, significant gaps noted in the literature.

This review revealed geographic and institutional disparities in trauma registry literature.

The majority of identified literature was concentrated in 21 countries and the most productivity was from 3 countries including South Africa, Uganda and Nigeria.

Conversely, 32 other African countries lacked an identifiable trauma registry. These findings are similar to those of previous systematic reviews of global trauma registry literature, which show Africa is falling behind. Most registries are single-centre institutional registries with very little consolidation to regional and even national registries.

The development of standardised instruments with clear data definitions for collection is one key facilitator for scale up from institutional to regional level (68). This review showed that there are notable gaps in Francophone and Lusophone Africa where many countries also lack a trauma registry. Most registries are found in large higher-level facilities in urban areas, leaving rural areas and the lower-level primary and secondary care public system largely underrepresented. These disparities mirror broader disparities in ‘trauma health systems’ development across the African continent (35) and within African countries (31) but are contrary to the idea of decentralising trauma care and capacitating

facilities in remote, rural areas where many injuries are sustained. Rural-based dwellers have poorer trauma outcomes because of the delay in receiving care and the nature of the injuries, as well as limited services nearby (69). The ideal African trauma health system should have facilities from lower-level primary care facilities well capacitated to respond to, recognise and refer more complex cases to increasing, well capacitated levels of care offering definitive care at the appropriate level and minimising inappropriate referrals. Another major gap is the private and NGO/mission hospital sector. In some countries these facilities provide a substantial amount of emergency care especially in underserved areas and even though they tend to have different levels of resources from hospitals in the public sector this represents a significant blind spot.

Reliance on attending healthcare workers for data collection is very common in this review. Literature identifies this reliance on busy clinicians as a key barrier to data collection in LMICs and also raises ethical concerns about disrupting patient care from overburdened clinicians. The fact that attending clinicians have limited time to correctly fill data collection forms is a key reason for creation of short, easy to fill data collection tools which are meant to simplify the data collection burden and reduce the disruption to patient care. Standardising clinical encounter has theoretical benefits to the process of care and ultimately to outcomes. However, use of a long form may potentially impede clinical workflow and impact outcomes. Use of standardised forms do lead to an improvement in the amount and quality of information collected (70) and use of a standardized trauma intake form (TIF) with real-time clinical decision support prompts improved process of care and importantly decreased the mortality rate for injured patients with impaired physiology on arrival. (71) The use of dedicated data collection staff avoids ethical and methodological issues with using someone directly or indirectly involved in a patients care that may affect their responses but may be impossible financially in some countries. In

addition, nonclinical staff may also need to be trained in medical terms, anatomy and traumatology to understand codes, treatment given and other concepts. The use of nonclinical personnel who are not already employed by government in the public hospitals may lead to lack of sustainability of registry data collection beyond the funded period of short-term research projects. (72)

The methodologies employed in the literature identified shows substantial variability in inclusion criteria, data collection practices and phase of care. Most registries focused exclusively on the emergency department as the first line in trauma assessment but neglect the admission, operative and rehabilitative phases of care. This narrow scope may limit the ability to evaluate longer term outcomes and the adequacy of rehabilitation as well as post-trauma disability which is an important determinant of the effect of quality of life after trauma. While injury severity scores are used widely in high income countries to define major trauma, their use is limited in LMICs due to their proprietary nature and cost and the extensive data needed to calculate them. Alternative scoring systems such as the Kampala Trauma Score (KTS) in its various incarnations, the Cape Triage Score etc and others have been used in the past but there are also issues with completeness of data required and their validity in predicting outcomes.

The design of trauma registries in Africa attempt to account for contextual factors such as resource and time limitations. They also aim to account for the common mechanisms of trauma, health system configuration and socioeconomic and cultural dynamics that are particular to African countries. Potentially useful variables that may be important for African registries include paratransit as a mode of transport. Paratransit is the term used to describe a diverse group of unofficial and often unregulated local transport options that may include: 2 wheelers, 3 wheelers, cars, minibuses, pickup trucks, and sometime larger buses. Examples include Bajajus, Boda-bodas, Matatus, Tuk-tuks and many others across

the continent. Data on injuries with these vehicles is relatively sparse and there is an opportunity to include this in a bespoke African registry where applicable. Variables on substance-related injuries particularly indigenous substances such as khat, kachasu, Tej and others consumed across the continent are another interesting element that is distinct from the usual alcohol and drugs as variables. Registries should also integrate data points supporting prevention policies, such as speeding, road and weather conditions and cultural and road conditions as well as secondary prevention such as helmets, child restraints and airbags to align with national and regional policy priorities. (73) These should map directly onto evidence-based interventions to support their utility. The measurement of socioeconomic status of trauma victims is a crucial unaddressed need in African trauma registries. In this review variables included for this are very sparse and are non-optimal. They use occupation, insurance status, highest education level of a parent or payment status as a proxy for socioeconomic status. But these are not useful for measuring relative or absolute socioeconomic status. Educational level and employment status have limited utility where there are high levels of unemployment or of informal employment. Insurance status is also of limited value when low benefits do not adequately protect from catastrophic expenditure or out of pocket payments or where they are proxies for employment. The new approach to this is by using composite indicators such as the multidimensional poverty index (MPI).

This study also provides information for adoption of the WHO surveillance guidelines. Our results show that these guidelines and the accompanying minimum dataset have modest adoption and are an influential model for adapted tools from around the world. In a systematic review from 2015, 49 countries from low- and middle-income countries used the guidelines and this number has appeared to have gone up since then. (74) However available tools from WHO are long and complex. The WHO minimum dataset has 74

variables, and the WHO clinical registry form is a detailed, two-page tool. There is a belief shared by many authors that short, simple tools are best for feasible trauma registries in LMICs. (75) This belief may potentially limit adoption of the tool. Although there is a trade-off between easier collection and comprehensive, useful data gleaned. There was almost no mention of data localisation and data ownership considerations in the literature which appears to be an underappreciated aspect of trauma data collection.

3.6 Conclusion

This scoping review provides an in-depth assessment of trauma registry literature in Africa, a continent that has particularly fallen behind in implementation of trauma registries. I highlighted methodological and operational fragmentation as well as moderate adoption of relevant guidelines from the WHO. While trauma registry literature has expanded considerably since 2000, the progress is uneven, with some countries with highly productive registries while others still do not have a registry, including Zimbabwe. The lack of registry activity in Francophone and Lusophone countries highlights the need for inclusion of underrepresented countries in trauma registry development. There is also an underrepresentation of rural and lower-level hospitals in trauma registry hospitals as well as public facilities in the literature. This disparity is reflected in broader trauma system inequalities and underlies the need to harmonise registries and other trauma system developments across the continent and strengthen surveillance in underserved areas. Our findings highlight the need to balance quality data collection with the realities in low-resource environments. The reliance on attending clinicians and the preference for concurrent data collection pose ethical as well as operational challenges. Trauma registry literature tends to focus on initial care in the emergency department with underrepresentation of the prehospital phase and rehabilitation phases of care, limiting the measurement of disability and granular description of the crucial events between trauma

and arrival at the final hospital. Inconsistent inclusion of important clinical parameters in the emergency department also limits the effectiveness of registries in measuring trauma severity and detecting deterioration of clinical condition. A major shortcoming of trauma registry literature is the exclusion of children and the inconsistent definition of a child that limits aggregation of data.

Trauma registries are largely still limited to scattered institutional registries with intercountry and intracountry fragmentation. I identified a “core” dataset of frequently used variables in the literature. To use in designing a bespoke instrument for use in Zimbabwe. Subsequent chapters will identify context specific risk factors to include in this tool as well as implementation and operational factors to use in its design. This list of variables will also be used in future work to further develop a consensus paediatric trauma registry for the African continent.

CHAPTER 4: Barriers and facilitators for implementation of a trauma registry in Zimbabwe

4.1 Background

Trauma registries defined as “ongoing, dynamic systems for collection of standardised data for individuals sustaining injuries based on uniform data elements” are a crucial first step in addressing injuries using the public health approach (76). They have played a key role in understanding trauma epidemiology, informing trauma quality improvement initiatives and guiding policy and intervention strategies. In high income countries, trauma registries have evolved into large databases linking hospitals across countries and regions. However, in LMICs implementation of trauma registries has proven to be challenging due to various contextual and systemic barriers. Many LMICs, particularly in Africa lack formal national trauma registries and those that exist are often fragmented, with inconsistent data collection at the hospital level (12). Zimbabwe, to the best of our knowledge, does not have an established trauma registry operating in any healthcare facility, creating a critical gap in trauma surveillance and trauma care improvement

The challenges to trauma registry implementation in LMICs have been a subject of much discussion in the literature. (77) Barriers such as limited finances, (26,78) inadequate stakeholder engagement (78) and competing clinical demands on busy healthcare workers (77) have been identified in the literature however these are highly context specific and there is a great deal of variation in local socio-cultural-political influences on implementation success (72,79). The literature on barriers to implementation in Zimbabwe is sparse or non-existent (11,80,81).

The first author was a part of a small team that contemplated introducing a registry in the country based on the WHO clinical registry in 2018. Despite high-level engagements with policymakers the initiative ultimately did not succeed. The reasons for this are unclear and must be understood if future efforts are to be successful. Subsequently, the first author sought to pilot a more customized registry, informed by a systematic review, in a hospital emergency department in 2023. This pilot faced significant adoption challenges related to practical operational issues. In recognition of evident barriers at multiple levels from operational level all the way to higher-level impediments, a deeper qualitative exploration of challenges and potential mitigation is warranted.

This study is particularly timely given the global emphasis on accurate and timely data for injury prevention and trauma care as part of the WHO's Global Plan for the Decade of Action for Road Safety 2021-2030, and recent calls from the UN to improve measurement of child and adolescent injury which the first author contributed to (73). By identifying both barriers and facilitators, this research aims to provide actionable insights that will inform future implementation efforts, ultimately contributing to the development of a sustainable trauma registry in Zimbabwe.

4.2 Chapter Aims

This study aims to provide an in-depth understanding of the barriers and facilitators to trauma registry implementation in Zimbabwe along the whole continuum of data production, usage and regulation using the socioecological model (Figure 17). We aim to provide insights that can be used in implementation and scale-up of a registry in Zimbabwean health facilities and that may be transferable to other countries.

4.3 Methods

This qualitative study employed the phenomenological approach.

4.3.1 *Study setting.*

This study was conducted in three of Zimbabwe's major tertiary government central hospitals located in Harare and Bulawayo between January and May 2024. These institutions were purposively selected because of their role as major referral hospitals for trauma care and as university training hospitals making them ideal candidates for initial trauma registry implementation.

4.3.2 *Identification, selection, and recruitment*

We employed a purposive sampling strategy using the maximum variation approach to select participants with authoritativeness of the subject matter. We aimed to assess barriers and facilitators from all stakeholders in the continuum from top to bottom using the socioecological model from those collecting and managing the data to those regulating and using it). We therefore targeted medical doctors from to specialists and heads of specialty and departments including surgeons and emergency medicine specialists. We also targeted nurses from junior casualty nurses to senior nurses, hospital records and HMIS staff, Electronic Health Records (HER) specialists, and administrative staff as well as policy makers. Inclusion criteria and rationale is shown below:

Table 10. Inclusion criteria/sampling framework

Participants	Characteristics
Junior doctors (junior resident medical officers in surgical firms), casualty officers, government medical officers, nurses, and other middle-level doctors	<ul style="list-style-type: none"> • Direct involvement in patient care and documentation in emergency departments and wards. • Experience with existing documentation processes (e.g., casualty forms, hospital notes). • Exposure to operational challenges like workload, equipment availability, and workflow integration.
Department supervisors, registrars, consultants, team leaders, or senior nurses	<ul style="list-style-type: none"> • Oversee clinical workflows and adherence to protocols. • Act as intermediaries between front-line staff and higher management. • Directly influence staff compliance and motivation for trauma data collection.
Hospital administrators, heads of departments (e.g., surgery, casualty), accounts and records department staff.	<ul style="list-style-type: none"> • Decision-makers for resource allocation (staffing, consumables, infrastructure). • Familiarity with hospital policies affecting data collection. • Responsibility for influencing staff compliance and institutional policies around data collection. • Responsibility for forwarding HMIS data to the Ministry of Health. •
Broader healthcare community, front office/reception staff, NGOs and private healthcare providers, electronic health records (EHR) specialists	<ul style="list-style-type: none"> • Knowledge of external systems that interact with trauma registries.
Policymakers, regulatory authorities, and funders (e.g., Ministry of Health, health professions authority, funding NGOs).	<ul style="list-style-type: none"> • Expertise in policy formulation, legislation, and healthcare regulation. • Ability to allocate financial and legal support for trauma registries. • Influence on national or provincial-level prioritization of health initiatives. • Insights into utilisation of data and data needs of policy makers
Broader societal influencers such as technology developers, economists, or health IT specialists.	<ul style="list-style-type: none"> • Expertise in policy formulation, legislation, and healthcare regulation. • Ability to allocate financial and legal support for trauma registries. • Influence on national or provincial-level prioritization of health initiatives.

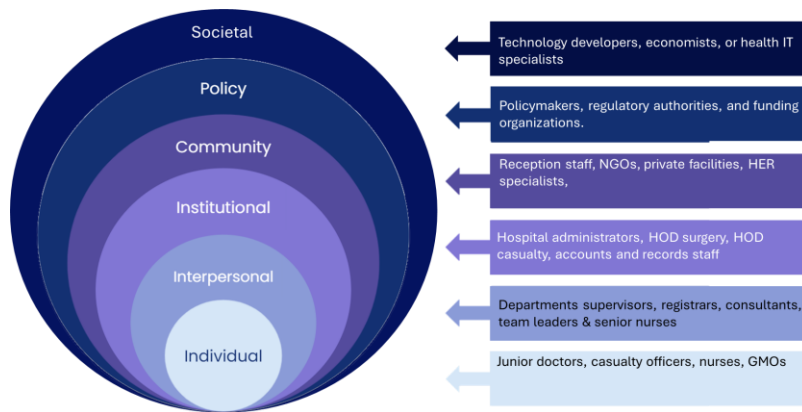


Figure 17. Sampling framework for participants.

We also identified additional participants through snowballing from interviewed participants and from a list of authors derived from a previous systematic review of Zimbabwean trauma literature (appendix 2). Previous literature suggests that saturation is usually achieved with 9 to 17 interviews in qualitative studies (82). Therefore, we anticipated that we would need at least 17 participants. Respondents were approached by email, phone or in person to participate in the study who were provided with information regarding the study objectives and the interviewers' background. In some cases, there was a prior professional or personal relationship between respondents and interviewer.

4.3.3 Data collection

Data were collected through a series of in-depth interviews conducted virtually or in person using a semi-structured interview guide using 5 domains of the Consolidated Framework for Implementation Research (CFIR) (appendix 5). The guide initially elicited information on the history of trauma surveillance in the country and then explored barriers and facilitators to implementation and suggestions for implementation and engagement. We defined barriers as ‘any factors that obstruct or impede’ the establishment or running of a trauma registry’ and we defined facilitators as ‘the factors that enable the implementation

of a trauma registry'. Where barriers were identified by participants they were asked for potential mitigating actions for each barrier. Each FDG lasted for between 30 to 50 minutes long. The data was audio recorded, transcribed and translated with consent of the participants. Field notes were also taken to capture additional observations. Participants provided feedback on the interview transcripts.

A small sample of casualty officers were also consulted specifically on trauma registry form design. They trialled a bespoke form and provided feedback on usability and utility through interviews and annotation. The data was collected by the first author who is a PhD candidate, and general surgeon who has worked in the same hospitals in the past. The first author also holds a relevant MSc degree.

4.3.4 Data analysis

Data was coded independently by two researchers, DM and MC. A coding framework was developed using a combination of inductive and deductive reasoning from a previous systematic review and from the data. Data was analysed thematically with themes and subthemes identified and described.

4.3.5 Ethics

Ethical approval was received from the University of Oxford Tropical Research Ethics Committee and the joint research ethics committee as well as Sally Mugabe research ethics committee. Approval to conduct research was obtained from each participating hospital. All participants provided both written and verbal informed consent to participate.

As some participants could be potentially identifiable from their comments, we decided not to label some participant quotes and to paraphrase them where potentially identifiable information was divulged.

4.4 Results

In total 20 people were interviewed. These participants have been described in Table 11.

Characteristics of study participants.. No participants refused to participate.

Table 11. Characteristics of study participants.

Variables	N
Participant occupation	
Surgeons	6
Casualty officer	4
Emergency physician	1
Junior doctor	2
Hospital records staff	2
Nurse	3
EHR specialists	2
Hospital	
Sally Mugabe hospital	6
Parirenyatwa hospital	11
Mpilo hospital	3

4.4.1 History of trauma surveillance in Zimbabwe

Historically, data on injuries in Zimbabwe has been of poor quality or non-existent.

Despite a well-developed health information system, there have been no known efforts to collect trauma-specific information, establish facility-based trauma registries, or aggregate data for unintentional trauma surveillance.

Regarding historical trauma registries: “Not that I know of. I have not heard of a registry at all even though over the years many have said we need one.”

“Outside of studies done for MMed dissertations I’m not aware of any registries.”

Previous data collection was limited to short-term university student research projects and dissertations. Funding and human resource constraints have affected the emergence of quality surveillance systems. One participant recalled the Msasa project which collected

high quality data on reportable gender-based violence cases that were managed in hospitals but not for unintentional injuries.

4.4.2 Personal experiences with Trauma Registries

None of our participants had direct experience with trauma registries in Zimbabwe prior to 2018. However, some had experience with other disease registries, such as the Zimbabwe Cancer Registry which is considered an exemplar of a functioning registry in the continent and provided useful contextual insights into the challenges and opportunities for implementing a patient registry in general. Others were involved in a brief effort in 2018 to establish a trauma registry based on the WHO clinical registry. This involved training of local champions and various engagements but the effort ultimately failed to get off the ground.

Regarding previous efforts at a trauma registry:

“We tried to introduce one a few years back but that didn’t work out.”

4.4.3 Barriers to Implementation

The identified barriers to implementing trauma registries were categorised into several categories including resources, operational barriers, regulatory environment, data-related barriers and issues related to utility of the data.

4.4.3.1 Resources

Financial resources

Participants consistently identified financial resources as a major barrier for initial setup and ongoing operation of trauma registries. Registries require sustainable funding for staff, consumables, operational and other costs. Participants noted that registries required

external NGO or government funding. Participants expressed concern that without this funding patient registries were bound to fail.

Regarding the cancer registry:

“There were a lot of donors that were interested in getting that set up, so they trained the registry people. That’s why it worked so well”

Regarding a trauma registry: “Without a reliable source of funding this is not going to work.”

An identified problem with funding was the perception of lack of sustainability. Both government funding and external NGO funding was considered at risk of cessation after a time period or unexpectedly withdrawn.

One dissenting opinion said there was fiscal space to pay for these kinds of initiatives and it was a matter of timing of advocacy during budgetary cycles.

Human resources

Human resources were also commonly identified as a major barrier to trauma registry implementation. The use of healthcare workers as data collectors was almost universally rejected by respondents. With already acute shortage of healthcare workers and already overburdened staff, it was considered infeasible to expect them to also take on data collection duties even when the form purported to improve their workflow or documentation rate of medical records. They stressed the need for dedicated personnel for registry management.

Casualty officer POV (point of view):

“Any sort of registry, if you do not train the person and they are not separate from the machinations of day-to-day, it will fall apart.”

“You need dedicated personnel to it and not just: OK, let's just get the ward secretary to do it, and I know that's what [they] will end up doing to say, oh, we can't afford to hire a new person. Let's get the nurses to do that amongst the many other things that they do.”

High attrition rates, due to economic migration of trained staff, further hindered the sustainability of human resources for trauma registry management:

“The moment you train people, you hear: Oh, she's now working in Egypt. Oh, he's now working in South Africa because of the better pay. So, [you can train] quite regularly, but because of the economic situation, [you] are training for export.”

There were however three dissenting voices (all surgeons) who considered collection by clinicians to be possible based on how clinical workflow used to function in the past.

“Maybe my perception may differ from that of the casual officers, but” ... “I don't understand this idea of it being difficult to fill. We used to do it. I don't know how we lost it along the way” ... “in the 90s and early 2000s, we had [long data collection forms] and we never had problems.”

“It's just reintroducing that culture. Once we get into that culture, there won't be any problem”

“There was a [meeting in 2019] with the GPs on [the WHO] form, we found out that it could be filled in about, I think about 8 to 12 minutes. One could be done with filling of the entire form.”

In response to this, junior colleagues expressed that despite some decline in health care worker morale, attitudes to clinical data entry were not the only reason for the low data entry capacity.

“So, when you were on duty, you were the only GMO on duty. You were supposed to cover ward rounds, in-patients, you're supposed to go to OPD, and you'll be the one on call.

“So, with that workload, I did not have the time to write three pages, honestly. You had the same attitude [to work], but [the workload] was higher.”

Technology infrastructure

Participants emphasised that technology should be appropriate to the local context. Issues such as inconsistent electricity and the risk of theft, loss or damage of expensive devices was highlighted.

“What about consistent access to internet or access to electricity to charge the technology. This could be an issue.”

“We can't put iPads in a district hospital, they will all disappear before the year is over”

Nonavailability of technology infrastructure at smaller and district level hospitals is also a barrier such as computers, input devices, and database storage.

The challenge of managing several uncoordinated technology systems in the different hospitals was highlighted by participants who noted,

“[In some hospitals], we are probably using more than five systems already.”

“They are not utilizing any interoperability standards such as FIHR and HL7.”

Consumables and operational resources

Participants highlighted that use of a new form would necessitate regular printing, distribution and resupply of the forms using the same mechanisms as other government hospital forms.

“Yes, [if it is printed on a normal home printer] that might be a barrier to use. If it comes on an official, recognised form, it will be easy to introduce.”

The availability of other equipment including secure boxes to hold forms, a separate office, stationary etc were considered additional costs affecting implementation feasibility.

The difficulties related to consistent internet access were repeatedly emphasised as barriers to digital adoption.

“We only have Wi-Fi at certain spots [at the hospital] but other areas don't even have network,”

emphasizing how limited connectivity can hinder the effectiveness of digital data collection tools.

4.4.3.2 *Operational barriers*

Integration into Workflow

The difficulty of integrating a new data collection form into the existing workflow of casualty departments was seen as a significant barrier. Existing forms are issued by the accounts department and therefore involve multiple departments making it difficult to change.

“That goes back to the whole issue of dedicated person for registry. Ideally you should be having someone who is running this, printing this, making sure it's in stock, and making sure it's filled out rather than convincing accounts to change the way they've done things for decades.”

Retrospective vs Concurrent Data Collection

Participants favoured retrospective data collection as opposed to concurrent collection, as the latter was deemed impractical during the initial patient encounter due to time pressures and emotional stress.

“Disrupting everything at once may cause chaos. So, we'd rather do it slowly.”

Form design and details

Participants shown the WHO clinical registry, the AFEM form and other similar forms as an example found them much too long and complex for concurrent data collection for busy clinicians to fill even if they improved capture rate of clinical information or improved assessment quality of trauma patients. With two pages, small font and multiple data points, they appeared even longer than they actually were.

“The poorly paid person who has got no time to spend with [the patient] because there's so many people on the bench.”

Long instruments (number of pages and number of items) are thought to be prohibitive. All but one respondent preferred a one-page document with a maximum of 20 to 30 items to fill

“The current casualty card is exceptionally brief, and it is filled out with very minimal data. The design of the form encourages that. Especially when you have a full bench. So, you can easily skip the whole card and just write at the bottom ENT to see.”

In situations where specific data points were difficult to obtain, healthcare workers will just ignore the section, resulting in incomplete data. In particular, vital sign data points require functioning equipment to be nearby. If they were not, they just interrupted the workflow and make the form frustrating to use.

“It’s too hyper detailed and not in keeping with the facilities I have in the hospital I’m in.”

On the Spo2 field:

“The spo2 probe got broken, it doesn’t work anymore. So, patients need to go to resus to get their spo2 measured.”

“This one that says weight for example. That would have to be an estimate. If the form actually said estimate I would quickly blow through that section”

“Even if the patient can stand, our scale was broken [some time ago] and the nurses were sending children down to [another ward] to get weighed if we really needed weight cos ours is not working”

“Some of these sections. It’s such a small little square, [on the form] but there’s so much history and work behind [getting it filled in].”

Respondents also said the complexity of the form needed to match the patient in different parts of the hospital.

“Why should I do [an] spo2, why should I do her bp, why should I weigh her” I can just write ‘ENT to see’ at the bottom because I can see she has a peanut in her nose!”

Participants noted a preference for simpler, streamlined forms with features like drop-down menus (in the case of digital forms), tick boxes and circles (written forms) rather than open-ended lines to ease the data entry process.

For example, having drop-down menus to avoid a lot of typing, and only type where it's absolutely necessary, like a patient's name or things that we can't really simplify further.

4.4.3.3 *Regulatory environment*

National laws and policies

Participants highlighted the absence of legal or policy support for trauma data collection as a significant impediment. Zimbabwe currently lacks legislation to mandate data collection for trauma registries in public as well as private hospitals.

“For a trauma registry you need to identify the appropriate legislation which in all probability supports you setting up a trauma registry because currently the laws don’t support me feeding the information I have to [the authorities].”

“Public hospitals are easier but private hospitals are much harder to get on board”

One respondent highlighted the impact of the lack of data collection and mechanisms for sharing data with policy makers, referring to a school just metres away from a hospital gate with an apparent observed high volume of child fatalities from road crashes.

“I don’t know who to give the information to. It needs to feed back to the traffic safety board.”

“The legislation doesn’t support me [to report back the patterns of injury I am seeing in my work]. Our legislation has not said it’s important.”

“You have to compel people to do it”

A "carrot and stick" approach were suggested, incorporating both engagement and incentives for data collection with legal obligations to ensure compliance.

Hospital/departmental policy

Participants noted that mandates should also come from the hospital or the relevant clinical departmental level to support implementation of trauma registries. Currently data collection is not prioritised at those levels.

“Nothing will be done unless the head of the department tells everyone that this is what you have to do. You need to put it into people’s contracts.”

Ethics/IRB requirements

The need for periodical renewal of ethics approvals and to obtain informed consent from every patient was identified as a barrier to data collection.

4.4.3.4 Data

Data sovereignty

An *extremely* important barrier to trauma registry implementation pertains to concerns about external data stewardship and sovereignty. There was notable apprehension regarding data localisation. Without data ownership trauma registries were likely to fail. It was considered a significant barrier of previous efforts.

Legal utility

Utility of trauma data as evidence for court proceedings and calling casualty officers as witnesses was identified as a potential barrier to engagement and consistent completion of the registry.

“People don't want to sign their names because they don't want to go to court for moderate and severe, which tends to go to court. “

“And now, with the collapse of the economy, they used to pay witnesses fuel transport for you to come [to court]. Now they don't. So, it's pro bono. It comes out of your own government salary to go to court.”

“The affidavit system discourages doctors to fill them properly”

Utility of trauma registry data for quality improvement in the casualty department was also identified as a potential impediment. If quality improvement initiatives were punitive and seen as witch-hunting exercises this could reduce engagement of casualty offices to truthfully and fully write the form or identify themselves on it.

4.4.4 Facilitators/mitigation

4.4.4.1 Resources

Financial

When funding may dry up you need a backup system to take over, if it doesn't have buy in from multiple actors or players it tends to fall apart. Need that dual flexibility

Need to use a combination of monetary and non-monetary incentives for multiple people.

Human resources

To mitigate the challenge of using busy clinicians for data collection various strategies were suggested. It was suggested that one either adds it to someone's job whom one is already paying, use nonmonetary incentives, or make it the duty of someone you don't have to pay.

A participant suggested employing a specific non-medical cadre, known as 'Medical Records and Health Information Technicians'. This is a new degree program with data and informatics students who also learn with health sciences students in physiotherapy, nursing, occupational health, anatomy, physiology and others. This or a similar cadre might be a useful group to run a registry without adding to the salary bill and increasing the experience of students.

"[Those students can] come like on a 3- or 6-month rotation, and they can [run the registry]"

"It would be an attachment which is paid by the NGO the way that we have developed our laboratory scientists is the same way."

4.4.4.2 Operational facilitators/mitigation

Participants suggested using a simple, short form with simple inclusion criteria (many depend on complex scores which are difficult to implement)

While long instruments are thought to be prohibitive. It was noted that private institutions in Zimbabwe use proprietary patient registration forms that in some cases are quite complex but seem to have high completion rates illustrating the influence of remuneration and environment on feasibility of forms. When asked why this difference between private and public one respondent answered:

“You've answered yourself. yeah, they're being remunerated commiserate with this detail.”

Participants emphasized the need to provide appropriate equipment alongside forms to ensure data can be collected efficiently, suggesting that simply distributing forms without ensuring proper infrastructure was ineffective.

One participant emphasized the importance of gradual transitions when implementing new systems, noting that rolling out digital tools too quickly in a large hospital could cause disruption.

Participants emphasized the importance of customizing the data collection tools to fit the local needs, stating,

“I think it's important for us to take our tool and go to the stakeholders who are supposed to enter this information... and then discuss with them what's practical and what's not... so that we just don't take the WHO [form] because it's WHO, but rather we implement it in a way that suits us... adopt it to what fits them.”

“If we just try to implement from high up down to the stakeholders, we'll face... resistance.”

4.4.4.3 Leadership

Effective leadership at multiple levels was identified as essential to registry implementation:

- Policymakers – an influential person to push favourable policies
- Hospital leadership and support – to sustain mandates and responsibility
- Local champion – to drive motivation

A designated, named person at each level was recommended by participants.

“In private hospitals you would have to make it mandatory by law for everyone to collect the same data.”

Participants suggested that now was an opportune moment for establishing a trauma registry because a lot of influential positions were currently held by surgical doctors who understood the problem.

Another participant suggested that departmental leadership was key to bringing back a culture of complete data collection that would facilitate health care worker data entry.

4.4.4.4 Stakeholder Engagement

Key motivators identified by participants were:

- Academic interest and publications
- Registry work as part of deliverables for one’s education
- The opportunity to get training to improve one’s marketability

Regarding the cancer registry: “So, when we were involved in it a lot, it was as students, and it was part of your duties. we were attached there. The fact that [we were] attached there meant that we understood the importance of data collection for a registry.”

Participants all emphasised the need to build broad-based buy in from multiple clinical specialities (general surgery, orthopaedics, neurosurgery, nursing etc and other non-medical stakeholders including the front reception, hospital records, accounts, the police etc to make it work.

“But if you don't have that, buy in, for example, the general surgeons want to start to start a trauma registry. If you don't get buy in from the people at the reception and say we need a meeting with information systems at [the hospital], they will always look at it as, oh, this is something that (sic) gen-surg are doing.”

Participant suggested that there was some inertia that could act as a barrier that could be mitigated by learning from the lived experiences of hospitals in other countries.

“One of the biggest barriers is who else has done it, how are we going to set it up, who are we going to copy from. How do we model it if we don't know what to look for to set it up?”

“How do we get the knowledge of one hospital's lived experience in setting up?”

4.4.4.5 *Technology integration*

Participants emphasised that registries should integrate with the already existing local EHR systems and have strict ownership and accessibility rules to be successful.

The data variables for the WHO clinical registry have already been incorporated as fields into the national EHR system. This is a key facilitator of integration of a future registry into the system.

“[So, they asked [some] doctors for inputs into the into that electronic record card. So [they were given] the template from the WHO [the WHO clinical registry]”.

Participants emphasised the need to integrate existing systems first and to make sure to introduce the registry with interoperability standards at inception.

When discussing future-proof technologies for the trauma registry, participants highlighted the potential of a cloud-based system, stating,

“We need cloud-based infrastructure... that will allow us flexibility. For example, later on, if we need to include any forms or standards or to scale up, to use it nationally or internationally.”

Table 12. Summary of barriers and facilitators to trauma registry implementation.

Category	Barriers	Facilitators/mitigation
Resources		
<i>Financial</i>	Insufficient funding and unsustainable external grants	Dual involvement of government and external NGOs so that if one fails the other will take it up. Earmarking internal funding mechanisms
<i>Human resources</i>	Use of busy healthcare workers with competing priorities A culture not conducive to data collection and technology adoption Significant training costs and the need for “workshops” for training each cohort of HCW Aversion to technology by decision makers	Deployment of specific non-medical cadres from polytechnics and local universities.
<i>Technology infrastructure</i>	Lack of data collection and storage infrastructure Lack of interoperability standards such as HL7 and FHIR	Using pre-existing infrastructure from accounts/records department Capacitate records department Mandate compliance with interoperability standards for all systems Network cables and access points are already available at one central hospital
<i>Consumables and operational resources</i>	Difficulty in sourcing and paying for consumables Power cuts	-
Operational barriers		
<i>Workflow integration</i>	Difficult integration of a new form	Use retrospective data collection
<i>Form design and details</i>	Unavailable or nonfunctional equipment	Use of a shortened, simplified form Using tick boxes and small fields
Regulatory environment		
<i>National laws/policies</i>	Lack of enabling legislation	

<i>Hospital/departmental policy</i>	Apathy and lack of engagement from leaders	Leadership and push from hospital and departmental leaders
<i>Ethics/IRB requirements</i>	Need to obtain consent and ethics	Separate registry designation for routine data
Data		
<i>Data quality</i>	Poor quality data prevents use for academics and policy	-
<i>Data sovereignty</i>	Data localisation preferences	Utilising local HER systems “Impilo”
Utility		
<i>Legal utility</i>	Use for court as evidence	Paying medical witnesses for appearances
<i>Academic utility</i>	Lack of research training among collectors	Encourages collection, visibility and use by policy makers

4.5 Discussion

This study contributes to the growing body of literature on trauma registry implementation in LMICs. The barriers identified in our research align broadly with those previously described in literature (83), including financial constraints, human resource limitations, technological challenges, and the lack of regulatory support. Our findings also identified some previously understudied barriers that often go unsaid when registries fail. This study also provides context-specific mitigations and recommendations for mitigation in Zimbabwe. While I identified multiple potential barriers in this research, the most *commonly* cited ones were **financial** and **human resource constraints**. The most *critical* barriers identified in Zimbabwe (those most important to success or failure) were **data sovereignty** and the lack of **regulatory support** for registries. To simplify advocacy for trauma registries, efforts should be focused on these barriers.

The financial and human resource limitations observed in our study are consistent with findings from similar studies in other African countries such as Kenya (84), Tanzania (25) and others (78). While other registries have persisted with healthcare workers as data

collectors through concurrent data collection, and tried to balance this with simpler data collection, this seems to be much more difficult in the Zimbabwean context from the point of view of casualty officers because of the workload and work environment. However, the dissenting views from (predictably) the senior surgical point of view seemed to suggest that this was due to a progressive decline of a ‘culture of diligent note taking’ over the years that could be mitigated with pressure from hospital and departmental level leadership. This may have been due to lack of perspective of senior surgical respondents for the daily issues faced by their junior colleagues in the present day compared to earlier years. Our study has unearthed a potential solution to the human resources problem that appears to be a persistent barrier in Zimbabwe. The suggestion of specific non-medical cadres who appear to have the right training and knowledge to run trauma registries is a novel and intriguing idea that should be explored as a potential solution with minimal impact on the wage bill. Using currently available personnel in the system for mutual benefit aligns with the approach many suggested. Financial contingencies to protect the registry from fluctuations in funding, such as dual funding and earmarked funding, were suggested and have facilitated sustainable registries in other countries. Financial vulnerability of trauma registries has been a problem since the first registries. The Illinois Trauma Registry (ITR) was the first state-based trauma registry in the United States from 1971 until a lapse in its funding led to its ultimate collapse 1976 (85). Resilience to financial headwinds is important even in high income countries.

Data sovereignty issues were an underappreciated, politically sensitive and often unspoken reason for failure of registries and may explain why this challenge is seldom if ever discussed in the literature. Multiple systematic reviews and qualitative studies of trauma registry implementation do not mention this barrier at all (77) (75) (24). Due to reliance on external funding, grants, and collaborative research projects, registries are often

proprietary, are not owned or controlled by governments or may feature real-time sharing of data to external organisations. Governments around the world are becoming increasingly reticent to allow data to be housed outside their borders and are exercising their agency over data. In Tanzania (the Personal Data Protection Act, 2022) and Nigeria (the Nigeria Data Protection Regulation (NDPR), 2019), for example there are strict data localisation and sovereignty laws requiring local storage and control over personal data. Similarly, Kenya (the Data Protection Act, 2019) and Rwanda (the Law on Data Privacy and Protection, 2019) have strong legal frameworks restricting cross-border transfer of personal health data. In Zimbabwe, data protection laws are moderately strict and section 28 of the Cyber and Data Protection Act, 2021 (enacted only after our first attempt at registry implementation) does allow cross-border data transfer with adequate protections and there is no specific mandate for medical data to be stored locally. Despite the lack of a relevant law at the time, attitudes to data sharing and security still have influence. While data storage and localisation arrangements tend to be an afterthought in many registries, our findings suggest they are fundamental to the success of registries and must be handled with sensitivity and strategic foresight. This may have quietly influenced the adoption of systems like the WHO clinical registry in the past. Using a registry that is perceived as locally built and owned and that integrates with existing local data structures, dashboards and Health Management Information Systems is a key facilitator.

Regulatory strategies to engage and compel private, NGO-owned and faith-based facilities to participate in data collection as well as the public sector are potentially useful for the future. Participants expressed that moves such as amendments to the Health Professions Council's facility 'Registration, Inspection and Renewal Manual' or creation of a formal 'trauma centre' designation for facilities to aspire to would be effective but would require careful engagement and support. Laws such as the Trauma Care Systems Planning and

Development Act of 1990 (national level), the California Health and Safety Code 1797.199 (state level), and hospital facility regulations/standard operating procedures provide for funding, reporting and establishment of trauma registries in the USA. Similar laws in the UK and other countries are key facilitators of successful implementation but are absent in Zimbabwe.

These findings also emphasise the need for utility of the registry to be built-in from inception so that the data is used and is useful for policymakers, researchers, administrative staff as well as other stakeholders to facilitate sustainability of a registry. Demonstrating this utility through pilot data is a key facilitator for implementation and is the subject of the last chapter of this work. Based on this research, I settled on a detailed two-page form with retrospective data collection soon after admission collected by non-clinical staff.

4.5.1 Limitations

This study has several important limitations that should be considered when interpreting the findings. Firstly, the study sampled from central, tertiary hospitals and excluded smaller, secondary level (district hospitals), primary care facilities and private sector facilities to understand the full gamut of barriers and facilitators across different levels of the healthcare system and assess any contextual differences in implementation difficulty across hospital system levels, facility sizes and governance structures that was only hinted at by participants.

Another limitation relates to my positionality as the researcher. I have worked and trained in the study hospitals as a medical student, junior doctor and surgical trainee with established professional relationships with many of the participants. This may have influenced both data collection and analysis and interpretation. These existing relationships

facilitated access to participants and rapport, they may have introduced social desirability bias during interviews limiting the kinds of information collected. In addition, my strong personal investment in establishing a trauma registry and opinions on design and operations may have influenced my interpretation and analysis of the results. This was mitigated by using independent coding by two blinded researchers. Member checking of themes and subthemes may have also helped to validate the interpretations.

The sensitivity of some topics, particularly concerning data sovereignty, may have limited participants' willingness to express their views fully or led to self-censoring, despite assurances of confidentiality.

For practical reasons I could not interview the highest-level policymakers and politicians which is a notable gap. Their perspectives are central to the implementation cascade for trauma registries. A policy dialogue in the future may be a rational way to fully explore the potentially complex policy-level barriers and enablers.

4.5.2 Recommendations

1. Develop enabling legislation – introduce policies that mandate or encourage collection of trauma data in health care facilities including amendments to health professions authority regulations or through creation of trauma centre accreditation requirements.
2. Simplify ethical approvals for patient registry collection to facilitate easy collection.
3. Deploy available non-clinical personnel, such as trained medical records or health informatics technicians, to collect data.
4. Appoint local champions and obtain leadership buy-in to promote registry adoption and foster a culture of data collection in clinical and non-clinical staff.

5. Integrate with existing systems and technology to facilitate interoperability and ease of data integration as well as acceptability.
6. Implement gradual scaling of registries – starting with single facilities and progressively expanding through all health system levels.
7. Produce a policy brief distilling this information into its simplest messages and prioritising key barriers for immediate action for policymakers.

CHAPTER 5: Systemic, Behavioural, and environmental risk factors for childhood injuries

5.1 Background

Injuries are a substantial public health issue globally, and notably in Zimbabwe. High-income countries (HICs) have successfully implemented preventive interventions based on a strong evidence base and a firm understanding of trauma patterns and burden, leading to a substantial reduction in trauma burden and death rates (86). However, progress in low- and middle-income countries (LMICs) has been slower and implemented prevention programs have had varied success (86).

The trauma system in Zimbabwe is relatively immature (35) and is at the beginning of its injury prevention journey with no nationwide surveillance system and few preventive programs having been implemented in the country (86). The public health approach to injury prevention requires identification and quantification of specific risk factors for injury before interventions are developed and tested. One potential factor contributing to the ineffectiveness of trauma prevention interventions in LMICs is the replication of strategies from HICs without considering the unique risks and contexts of LMICs.

Interventions should be developed for each setting based on its unique risk factors and ideally using participatory methods to ensure context-specific relevance and uptake by the community and other stakeholders. Zimbabwe has faced unique socioeconomic challenges over the past decades with deprivation from the household and family level to the macroeconomic level evident. 60.7% of all children in Zimbabwe are considered multidimensionally poor (87). The influence of these on injury risk in the country especially on its most vulnerable population, children remain largely unknown.

There is a conspicuous gap in the recent Zimbabwean literature for trauma risk factors. Some prospective epidemiological studies exist that focus on clinical management of injuries (88) however relatively little has been written on primary prevention and risk factors. In this study, we aimed to understand the context-specific risk factors of common childhood injuries in Zimbabwe from the perspective of injured children, their guardians and health care workers through in-depth interviews and focus group discussions. We also aimed to elicit from them potential interventions for injury prevention from their perspective. We hope to aid in the development of future bespoke targeted interventions for injury prevention tailored to the different unique contexts in Zimbabwe. This research seeks to contribute valuable insights for policymaking, intervention development and implementation.

5.2 Methods

5.2.1 Study design and setting.

This was a qualitative study using the grounded theory method conducted at four tertiary government hospitals in Zimbabwe. This study uses the pragmatic approach which emphasises the practical application of the findings and utility for solving real world problems. The study was conducted at 3 major central hospitals in the public sector located in Harare and Bulawayo in Zimbabwe. These two cities are the biggest cities in Zimbabwe spanning ethnic, geographic, and cultural diversity in the country. The study hospitals are responsible for providing comprehensive care to injured patients with specialist and super specialist expertise and diagnostic services. These hospitals house the only burns units in the public healthcare system, as well as the most specialised surgical expertise and availability of advanced diagnostic facilities. They are the final referral centres for major trauma in the country.

5.2.2 *Theoretical framework*

The study was underpinned by a pragmatic approach, focusing on the practical application of the findings for solving real-world problems. This orientation guided the design, data collection, and analysis processes. We used a combination of an inductive and a deductive approach to theory development drawing from the already extensive literature in road safety, burns prevention and child injury prevention while augmenting and modifying frameworks to the local context. For burn injuries we used elements of the American Burn Association Burn Prevention Framework that aims to assist in developing a successful burn prevention program and the Morrongiello and Corbett framework for young children's risk of unintentional injury (89). A framework for road traffic crash risk by Wazana et al was used to inform risk factors for this injury cause (90).

5.2.3 *Participants*

Inclusion criteria for this study:

- Parents or guardians of children aged (0–18 years inclusive) at the time of injury admitted to a participating centre with trauma (top two causes of trauma i.e. burns, and road injuries) OR
- Such eligible injured children old enough to respond to questions OR
- Nurses involved in the care of injured children.

The following exclusion criteria were applied:

- Children with other causes of unintentional injury
- Children with birth injuries and iatrogenic injuries
- Intentional injuries (non-accidental injuries), or those for whom there were significant safeguarding concerns.

5.2.4 Selection, sampling, and recruitment

Participants were selected through purposive sampling using the maximum variation approach to ensure a diverse cross-section of ethnicities, injury causes, socioeconomic statuses, geographic regions and other demographic characteristics. Initial participants were identified by key informants including ward nurses and attending doctors as well as the hospital social worker. We also screened admission records of the participating hospitals periodically to identify potential participants and finally we identified participants through snowballing from participants once interviewed. Recruitment was continued until saturation was reached.

Participants were approached face-to-face by the researchers who provided information about the study and invited them to participate. There was no prior relationship between the researchers and the participants before the study commenced. Participants were informed about the researchers' academic and professional backgrounds, as well as the purpose and goals of the study. Age-appropriate participant information leaflets in the local language were given to parents and children where appropriate to peruse and informed consent was obtained from the parents and assent from the children before the interview started. The researchers disclosed their interest in researching childhood injuries and their commitment to improving injury prevention in Zimbabwe. Two interviewers (DM and MC) conducted the interviews DM is an indigenous male clinical researcher with an MSc and SM is an indigenous female researcher and clinician. Both have experience in qualitative research, have completed relevant training and they are currently not involved in trauma patient care.

5.2.5 Setting, research team, data collection

Data was collected through in-depth interviews and focus group discussions with participants. A semi-structured topic guide was developed based on literature review and expert consultation (Appendix 6). It included questions about risks of injuries, perceptions of causes and attribution of injuries. The guide was pilot tested with a small group to refine the questions. All interviews and focus group discussions were audio-recorded with participants' consent to ensure accurate data capture. Field notes were made during and after the interviews to capture non-verbal cues and contextual details. Each interview and focus group discussion lasted between 20 to 45 minutes. Data saturation was achieved when no new themes emerged from the interviews and discussions. No repeat interviews were conducted, and transcripts were not returned to participants for comment or correction due to logistical constraints.

Data collection took place in private rooms within the hospitals to ensure confidentiality and comfort for patients. Only the participants and researchers were present during the interviews and focus group discussions. Interviews and focus groups were conducted by author DM (male) as well as qualitative researcher MC (female). All researchers held advanced degrees in relevant fields: DM has a relevant MSc and is a doctoral candidate, MC has a relevant MSc degree. At the time of the study neither worked at the respective hospitals. Both had appropriate training in qualitative research methods. Interviews were conducted in English, Shona and Ndebele as principal languages depending on the patient's language preferences and the pertinent region. The interviews were audio-recorded with the consent of the participants, and field notes were taken during the interviews to capture non-verbal cues and observations. The interview explored the following main areas: sociodemographic information, participants perspectives on what

puts them at risk/causes of injuries and their perspectives on mitigation for these risks and interventions that could help prevent respective injuries.

5.2.5.1 Data analysis

Data was independently coded by two researchers DM and MC. A coding framework was developed using a combination of inductive and deductive reasoning from the data and existing frameworks respectively with themes and sub-themes identified through iterative discussions and taking into consideration the literature on the subject. We performed code frequency analysis of identified themes to understand the relative contribution of each.

5.2.5.2 Reporting

This chapter has been prepared consistent with the COREQ guidelines.

5.2.5.3 Ethics

This study was conducted under ethical approval from the participating centres, the Sally Mugabe Central Hospital Ethics Board (SMCHEC80422/57), the Joint Research Ethics Committee (221/2022), and the Oxford Tropical Research Ethics Committee (543-22).

5.2.5.4 Patient and community involvement

A local road safety NGO staff member, and a community representative (a mother of a child burn victim) provided feedback on the study documents (patient information sheets, consent, and assent forms as well as topic guide and information leaflets). Feedback was elicited during design, implementation, and analysis phase.

5.3 Results

In total 43 people were interviewed. These included 32 child/guardian pairs, 5 focus group participants and 6 nurses. Only one participant refused to be interviewed because they were tired.

5.3.1 Demographic characteristics of participants

Of the 32 child/guardian pairs, 30 of them were females (mothers, grandmothers, and aunts of the injured child) and 22 of them were mothers. Most of those interviewed were educated up to at least secondary school level. These and other characteristics of participants are shown in table 13.

Table 13. Socio-demographic and clinical characteristics of study participants.

Variables	N (%)
Age of Child	
0 to 4	18
5 to 9	5
10 to 14	7
14 to 18	2
Family situation/Marital status	
Both parents together	9
Single parent	15
Single orphan	7
Double orphan	2
Number of siblings	
0 (only child)	4
1	11
>2	17
Highest education level	
Less than Primary school	13
Up to secondary school	18
Up to college graduate	1
Injury cause	
Burns	19
Road traffic Crash	13
Other	0
Type of Participant	
Patient/family	8
Mother	22
Father	2
Nurses	6
Municipal nurse	1
General ward nurse	2
Burns Ward nurse	3

5.3.2 *Injury risk factors and potential interventions.*

5.3.2.1 *Burns*

We identified multiple potential context specific risk factors for childhood burns. Burns occurred when certain key routine activities were taking place *in addition to* a combination of behavioural, child, environmental and systemic factors that are unique to the various contexts (table 14).

Activities

The participants highlighted specific household activities that facilitate burn risk. Participants frequently mentioned boiling water for cooking and bathing as routine activities during which burns typically occur.

Another unique, novel activity identified was boiling water for the therapeutic inhalation of steam (known colloquially as “kumatira”) as a household remedy for flu and coughs as well as for home treatment of COVID-19 (said to have been used widely in the community during the pandemic and after). Both nurses and patients alike noted that during the COVID19 pandemic there had been an appreciable increase in burns of the face or body attributable to this practice in the community.

Behavioural factors

Lapses in child supervision was a recurring theme. Participants almost universally agreed that lapses in supervision were necessary for a child to sustain a burn and that without it a burn would be unlikely to occur. Reasons identified for such lapses included.

- Having multiple children especially a younger child who required constant attention plus an older child who was more mobile.

- Leaving the room to fill bathtub, (especially needing to fill a hot water bucket more than once)
- Supervision by a younger or inexperienced child minder.

“I would say there is a lot of times when we are unaware of the child’s whereabouts and activities... for us mothers let’s be aware of where the child is at all times.... even if [we have to] get someone else to watch them.... so that we don’t get affected by the guilt of this kind of situation. we can prevent a lot by being vigilant.”

A key protective factor identified was having childcare help (either hired or family help).

One caregiver explained how the activity plus the inattention were both necessary prerequisites:

“Burns tend to occur in the time between boiling the hot water and fetching the cold water to cool it down to safe temperature.”

Many parents admitted to moments of inattention (with associated guilt) or assumed that inattention was a factor when they were not present during burn incidents.

Key modifier of this risk was heating the water too much because of the preference for more bathwater and low capacity of the buckets, necessitating multiple trips from bathroom to kitchen.

There was a suggestion among health care workers and participants that the incidence of burns was related to changes in energy use patterns, from electricity to gas or open fire especially in specific areas with power cuts or load shedding. This increasing popularity and preference for gas and open fire was related to price differentials and consistency of these sources versus electricity at times.

Participants also identified lack of knowledge on how to safely store or use gas tanks in the home and prevent tank explosions or fires.

Many patients admitted that they had heard of a lot of gas tanks exploding in the communities and that this was a fear of theirs.

Child factors

Factors related to child development including increasing mobility, height and curiosity were all factors that were identified as leading to burns around a certain age and that child proofing needed to be appropriate to the age and height of the child.

Environmental and equipment factors

The design of the living environment and design of available household equipment were also identified by participants. In single or two room living arrangements, household chores involving hot water were performed in the same room where the child was playing, sometimes on the same plug with no dedicated area to use and store LPG, and no tables. The challenges of preventing accidents are compounded by the lack of space and the accessibility of dangerous items to children in confined living environments. One participant noted:

"We boil the water in a kettle jug in the dining room where the TV and radio are plugged in,"

Illustrating the hazards associated with these activities and the influence of one-room living on burn risk. Another noted:

"I really hate gas. It's very risky, especially in small spaces where children can reach it The environment is small and there is no space for the child. it's a gas tank that's just put in the corner of the room. it's different from the arrangement that we use in the rural areas. where the cooking will be done in the kitchen and if I want to prevent burn accidents, I can just close the door to the kitchen".

We also identified scepticism among participants of manufacturing quality of LPG gas tanks for sale:

"Many gas retailers are operating illegally because these tanks are very popular these days, I think they are poor quality".

Use of “top burners”, (single-burner LPG gas stove attachments) was mentioned as particularly problematic due to their instability (top heavy) and accessibility to children at a lower age and height.

The small spare-part “the rubber”, or “washer” (properly called a gas-regulator washer) used to seal gas tank attachments was identified as a common point of failure.

Novel heating equipment (frugal innovations) such as heating jug/bucket and electric immersion heater rods/elements which are sold on many street corners were also implicated as scald and electrical burn hazards. While extremely affordable and useful for household chores when tapped water isn’t available, their height accessibility to children, lack of safety features and mass manufacture in home industries were considered hazards.

Systemic factors

The macro social and economic situation was repeatedly brought up as an overall factor affecting everyone that interacted with all of the above factors. The economic situation was identified as ultimately responsible for activity and behaviour changes (in households), the increased use of various technologies (gas tanks, top burners, immersion water heater elements, element buckets, two-plate stoves), power cuts, lack of home proofing, increasing price sensitivity of energy consumers and changes in different industries in ways that further made the environment unsafe.

One participant noted:

“The electricity cuts have led to use of alternative means of energy such as gas, firewood, and solar energy. The increased demand for gas has led to illegal gas retailers and substandard gas tanks.”

Table 14. Risk factors identified by participants for burns injury and identified interventions for risk factors.

Risk factors	Identified interventions
Activities	
<ul style="list-style-type: none"> • Routine and non-routine household activities 	-
Behavioural/individual factors:	
<ul style="list-style-type: none"> • Lapses in child supervision 	Get childcare help (family, hired)
<ul style="list-style-type: none"> • Attitudes to child supervision 	-
<ul style="list-style-type: none"> • Energy use patterns and preferences 	-
<ul style="list-style-type: none"> • Knowledge of risks of faulty gas equipment, handling, and safe storage 	Education
<ul style="list-style-type: none"> • Overheating bath water, multiple pots/buckets 	Design higher capacity heater buckets
Child factors	
<ul style="list-style-type: none"> • Developmental factors (grasp, walking, height) 	-
<ul style="list-style-type: none"> • Behavioural factors 	Restrict child behaviour
Environmental and equipment factors	
<ul style="list-style-type: none"> • Design of homes 	Engineering solutions: Construct enclosed lockable storage for gas tanks and coking area tables. Impede access for children. Context appropriate childproofing
<ul style="list-style-type: none"> • Quality, design, and Stability of Equipment 	
<ul style="list-style-type: none"> • Use of “top burners” 	Design top burners to be more stable with “legs”, brackets or ban top burners
<ul style="list-style-type: none"> • Poorly designed or uncertified LPG gas tanks. 	Strengthen enforcement of licensure Public awareness of poor-quality brands
<ul style="list-style-type: none"> • Substandard replacement “gas-regulator washers” 	Public education and enforcement
<ul style="list-style-type: none"> • Novel heating equipment (frugal innovations) such as heating jug/bucket, electric immersion heater rods. 	Design of heater buckets fitted with a cut-off switch linked to a thermostat to prevent overheating. Ban of select items
<ul style="list-style-type: none"> • Lack of electric stove ownership 	-
<ul style="list-style-type: none"> • Unavailability of tap/piped hot and cold water in homes directly in bathroom. 	-
<ul style="list-style-type: none"> • Unavailability of a geyser 	-
Systemic factors	
<ul style="list-style-type: none"> • Broader macroeconomic environment: community more price sensitive, less disposable income to purchase home items such as geyser, stove etc. 	Systemic economic improvement
<ul style="list-style-type: none"> • More expensive electricity vs cheaper gas prices 	-
<ul style="list-style-type: none"> • Regulatory environment 	Make LPG regulations easier to follow
<ul style="list-style-type: none"> • Power cuts and load shedding 	-

Table 15. Codes, definitions, and code frequencies for qualitative data on risks and causes of burns.

Code	Operational definitions	Number of interviews where code was mentioned	Total number of references for the code	Example quote from participants
Behavioural/individual factors:	Participant describes actions, attitudes, and knowledge of guardians	19	51	"We need to be aware of where the child is at all times. Even if it's about getting someone else to see them."
Child factors	Participant describes characteristics and behaviours of children	14	34	"Children are always naughty, that will always be the case"
Environmental and equipment factors	Participant describes physical aspects of the living environment and household equipment	17	45	"I have heard of a lot of gas tanks exploding in the communities and that this was a fear of theirs."
Systemic factors	Participant describes issues at the highest level of influence such as international, national or provincial level factors	19	39	"They need to change the laws on manufacture of these tanks, it's just too much, they are too unsafe"

5.3.2.2 Road traffic injuries

Through interviews with parents and health care workers we also identified multiple potential context-specific risk factors for the occurrence of road traffic crashes in children.

We used a modification of pre-existing framework to classify risks (90).

Social and cultural

We noted differing attitudes to child supervision on the roads. Some participants believed that children should be able to walk themselves to school from a very young age and were

comfortable with this if the parent had taught them road safety. Confidence in unaccompanied walking was heightened if the child was taught the rules of the road at school or by a parent who had themselves been taught the rules of the road at school. Among participants we identified children who had been walking to school from as early as ECD B (children aged 4 to 5) with their parents blessing.

“When he’s in ECD or maybe grade 1, I will walk with him. but after that then he should be able to walk on his own.”

Others expressed fear at leaving the child to walk alone for fear of road crashes but admitted that they wouldn’t be able to because of work.

“It scares me a lot, that’s why whenever I see him, I am always telling him the rules of the road and telling him when you’re walking, walk like this.”

Some mothers still admitted that their attitudes about unsupervised walking had changed since their child had been involved in an MVA. A frequently identified perceived protective factor was if the child is walking with peers from the same school.

Physical environment

“The way I see it, the road is filled with potholes, and this forces the combis and other private cars to drive off the road on the sidewalk which is dangerous.”

“There are also small piles of rubble next to each pothole, but they haven’t been filled so that further blocks the way for cars to pass and they end up snaking around trying to avoid the piles.”

“It’s hard for pedestrians. We end up asking” [tongue in cheek] “so should we now walk in the bush since there’s really no road to talk about in some areas.”

“They should at least put some speed humps on the road because cars drive too fast past the school”.

“Ah the road is terrible doctor; the road is very bad.”

Drivers

A prominent theme was driver attitudes, negligence, or recklessness on the roads as a cause of crashes. Code frequency analysis identified that this was one of the most cited factors (table 16).

Table 16. Risk factors identified by participants for road traffic injury and identified interventions for risk factors.

Risk factor	Identified interventions
Social and cultural	
Supervision of children to school	Walking with peers or trusted adult
Behavioural	
Playful, naughty child personality	Strict discipline
Recreational drinking in adolescents	Drink-driving awareness campaigns
Reckless driving in adolescents	-
Physical environment	
Integrity of road infrastructure, potholes and inadequacy of speed bumps and other traffic calming measures.	-
Driver	
Attitude and adherence to the rules, speeding, drinking	Increased stringency of enforcement
Vehicle	
Unroadworthy cars and, second-hand cars, temporary use spare tyres (TUST or “biscuit wheel”)	Increased stringency of enforcement

Table 17. Codes, definitions, and code frequencies for qualitative data on risks and causes of road traffic injuries.

Code	Operational definitions	Number of interviews where code was mentioned	Total number of references for the code	Example quote from participants
Social and cultural	Participant describes <i>community</i> and cultural attitudes	11	31	“He should be able to walk alone, he is old enough now, like we all were when we were young”
Behavioural	Participant describes <i>individual</i> behaviours and traits	12	40	"People don't pay attention to zebra crossings on the road therefore sometimes the road is so busy that one cannot cross safely at all."
Physical environment	Participant describes the condition and design of the physical environment	12	23	"The way I see it the road is filled with potholes, and this forces the combis and other private cars to drive off the road on the sidewalk which is dangerous."
Driver	Participant describes driver behaviours and attitudes,	13	45	"The driver who hit him was said to have been driving fast. He even wanted to run away after the incident."
Vehicle	Participant describes the condition and safety of vehicles,	6	18	“Many cars have the biscuit wheel and are unsafe on the roads”

5.4 Discussion

In this study, we sought to understand and explore contextual factors influencing the risk of various common childhood injuries in Zimbabwe from the perspective of parents and guardians of admitted children and nurses. Through qualitative analysis of in-depth interviews and focus group discussions with parents, guardians, and nurses, we uncovered multifaceted, interrelated factors influencing injury risk. Our findings provide insights into the attribution of cause and assignment of blame by participants and perspectives on interventions to mitigate and prevent these. It is evident that these injuries result from a combination of individual, community, environmental, and systemic factors and risks.

Our results demonstrate that the influence of the underlying systemic factors as well as environmental factors is prominent in injury risk. Zimbabwe is classified as a low-middle income country however large inequalities in wealth exist (91) (8). Our participants (patients likely to attend public health facilities) are assumed to be in lower wealth quintiles however socioeconomic status can be difficult to determine. Dimensions of household deprivation may be more useful in accurately describing socioeconomic status than traditional income-based and household asset questionnaires and some may link with household injury risk including cooking fuel usage, electricity availability, and housing arrangements (92). Overall, 34% of households in Zimbabwe have access to electricity, however in urban areas as high as 81% of households have access vs 10% of rural households (93). Water for bathing is heated in electric storage heaters in higher wealth quintiles while it is heated on electric stoves or other means in lower-income households and by woodfires and paraffin in rural households (94). Burn injuries in rural areas identified in this study all followed open flame use while water heated by other means in urban areas was implicated. We also interviewed families originally from rural households who were burnt during visits to urban family members underscoring the importance of setting. Housing configuration and one-room living was identified as a risk factor by our participants. 36% of Zimbabwean households have one room used for sleeping and another 36% have two rooms (93). This agrees with the results of a 2010 unpublished dissertation that identified “using the same room for sleeping and eating” as a risk factor for scald burns that increased the odds of a burn by 5 times. Multi-habitation (multiple families are contained within one dwelling made for one family, sharing common facilities) (95) was identified by participants as a risk factor. Multi-habitation is a common housing arrangement in urban Africa (96). Energy use patterns corroborate the theory that LPG gas usage has been increasing at the expense of electricity use. Demographic and health

surveys show increasing LPG usage over the years (93) from 0.4% of urban household to 7.9% and 0% of rural households to 0.9%. the results of the latest DHS will confirm if the trend continues. Load shedding and electricity outages are not only implicated in changing energy use patterns but also in causing burns themselves (97). This has been demonstrated in Cape Town, South Africa (97,98) but has not yet been shown in Zimbabwe.

Household burns are a major reason for admission for burns, making up 79% of admitted burns treated at Mpilo hospital in 1997. Scald burns were the most common cause of burn injury admissions in 1999 at Mpilo hospital, while exploding primus stoves and lamps were a relatively common cause that has since diminished as their use has declined (88).

While the use of paraffin as a fuel source has declined, the configuration of Primus stoves is similar to the single plate LPG gas arrangement that is gaining popularity in Zimbabwe.

(99) Their inherent instability, high centre of gravity and common position on the floor make them hazardous to crawling and walking children. (100)

Our enquiry into road crashes also revealed several contextual risks. The cultural practice of allowing children to walk alone was implicated in the risk of road crashes in children. In high-income countries, the rates of independent mobility dropped substantially, while in Africa, rates seem to be persistently high. For example, in Australia in 1991, 68% of children under 10 were allowed to walk home alone from school, whereas by 2012, that number had dropped to 9%. In Africa, however, rates of independent mobility have remained high, with more than 95% of children walking alone to school. (101) (102)

Participants admitted that they were reconsidering this custom, however this may be an artefact of having been through the experience of being admitted for a road crash. There was some suggestion among participants in this study that this was considered a rite of passage for children, while others wished they could accompany their children and were concerned about the risk of crashes but could not do so because of work commitments.

Studies from South Africa similarly reveal that there is a high degree of parental concern about the safety of children walking alone to school but despite this, they also were unable to change the mobility situation of their children. (103) The American Academy of Paediatrics recommends that children less than 10 years of age should not be allowed to walk alone because of immature developmental and cognitive skills. (104) Some of our parents expressed satisfaction that they had taught their child the rules of the road, which gave them confidence. However, the literature suggests that this is unlikely to be protective below the age of 10 years (105) and may even lead to overconfidence. (106) Even promising new educational techniques cannot be effectively taught for certain cognitively complex tasks such as mid-block crossings. (107) therefore caution should be taken when assessing parents' confidence with children they have taught the rules of the road. Our study identified poor road condition and inadequate traffic calming infrastructure especially around schools as a major risk factor for road crashes from the perspective of participants. This is a potentially important aspect for intervention and is potentially amenable to cost effective assessment and intervention that has been successful in Tanzania and other countries. (108) While these contextual individual risks are important to identify, it is important to note that a systems approach, rather than a piecemeal approach to road crash prevention, is most effective and evidence-based. (109)

In our study, from the perspective of admitted patients, there was a tendency to attribute injury risk to human or individual behavioural factors more than systemic or environmental factors. Person-centred safety approaches have largely been replaced by system-centred safety paradigms (110) such as the aforementioned safe systems approach for road safety as an example (111) but they persist in the community (112) and media (113).

This phenomenon has implications for the corresponding intervention functions suggested by risk factors because human factors (knowledge and behaviour) are addressed through awareness raising and educational interventions. However, knowledge of injury risk or recognition of hazards for household injury does not necessarily influence how parents behave (89) (114). Similarly, road safety education as a stand-alone intervention is now considered ineffective in changing behaviour (115) or reducing the incidence of crashes while product modification, environmental redesign and legislation are more effective than education (116) (117).

Attribution of risk by patients and their caregivers may influence their motivation and ability to develop avoidant strategies in future (118) or their belief that injuries can be prevented. Caregivers might feel a sense of helplessness against systemic or environmental risks and a sense of guilt and personal responsibility for human-level factors potentially hampering or helping prevention efforts (112).

5.4.1 Limitations

This study has several limitations that should be considered when interpreting the results. First, participants were exclusively drawn from public sector, central hospitals in Harare and Bulawayo, which may not represent the risk perceptions and experiences of the broader community, including those who frequent private and mission healthcare facilities, those in other major cities or those who do not seek hospital care, have not been admitted and importantly those who could not make it to the hospital at all. This, therefore, represents significant selection bias. Also, the members of the general community who do not have an injured child may perceive risks differently. This limitation may skew the findings towards the experiences and perceptions of the sampled groups. I attempted to incorporate the perspectives of bereaved mothers of injured children, but this was not possible for logistical reasons. Eliciting the experiences of those who don't make it to the

health system at all requires a community-based/household approach, which is resource intensive and is the remit of future work currently underway. In addition, the sample consisted of predominantly female caregivers or guardians with very few male caregivers such as fathers, grandfathers and uncles. This gender imbalance may have influenced which risk factors were identified and the mitigation or preventative factors suggested.

This study is also susceptible to recall and attribution bias due to its reliance on past events self-reported by patients still in the hospital. The recollection and interpretation of past events may be affected by the psychological stress that parents and guardians are currently experiencing. They may attempt to make sense of their situation by attributing the injuries to causes that align with their personal experiences. While these experiences are valid, they are influenced by who provides the information and when it is solicited. There may be an overemphasis or underemphasis on personal responsibility factors compared to external factors in cause attribution. Social desirability bias may also have affected the perspectives provided, especially regarding parental supervision, home safety, and lapses in supervision.

My own positionality as a local Zimbabwean doctor with an established career in Zimbabwe's healthcare system may have influenced the responses given by participants during interviews, they may have felt compelled to give certain responses that they believe align with medical perspectives and the power imbalance may have limited discussions around structural, political or economic factors, as well as very personal, sensitive issues. Participants were fully appraised of my role in the hospital and in the research to mitigate any fears they might have. My positionality as an injury prevention researcher may also have influenced the analysis and interpretation of the results. This may potentially have led to an emphasis on environmental factors rather than personal behavioural factors.

Logistical constraints prevented performance of repeat interviews and the return of transcripts to participants for verification, which could affect the accuracy and reliability of the collected data. I did however reach thematic saturation in the collected data.

5.4.2 Future research

Factors identified in this study will be investigated quantitatively to assess their contribution to injury risk and incorporated into injury risk assessment studies. Eventually these will find their way into home hazard assessment tools. There is also a need to assess the interventions identified by admitted patients for feasibility and appropriateness at the policy-level as well as their effectiveness against the evidence base for injury interventions.

5.5 Conclusions

This study provides insights into context specific risk factors for childhood injury among admitted patients in public hospitals in Harare and Bulawayo. By utilizing qualitative methods to capture the perspectives of caregivers, children, and healthcare providers, the research highlights the significant influence of socio-economic conditions, living environments, and individual behaviours on injury risks. The study also provides suggested context and risk-specific interventions for mitigating injury risk in the respective settings (household and road). The results are expected to contribute to the development of bespoke interventions for injury prevention in Zimbabwe ensuring they are tailored to the unique challenges and realities faced by Zimbabwean communities and ensure the perspectives of the community has been considered.

CHAPTER 6: Exploring injured patients' experiences in Zimbabwe through a journey map

6.1 Background

Zimbabwe's trauma system needs are complex. It must provide care to its 15.2 million people, 67% of whom live in rural areas, sometimes far from the appropriate care for their injury. Those living in Zimbabwe's densely populated urban areas, while closer to care, also often have to navigate the health system through different tiers of care encountering multiple barriers (119). Zimbabwe's pyramidal health care system provides increasingly advanced trauma care as one ascends the system from primary care to quaternary care (16). The Ministry of health has defined the core health services that should be provided at every level of care in its Core Health Services package (table 1) and injury is relatively well represented, however gaps and opportunities do exist. There may be under or over utilization of services at each level for various conditions based on facility capacity, patient perceptions and preferences (120) (121). The primary care system is a crucial resource for community-based care in various parts of the country however they are mostly expected to provide antenatal care, immunisations, and maternity services (122) which they have succeeded in doing well over the years for some time. It is unclear however, what part they play in the overall trauma system. In the secondary healthcare level (including district hospitals) limited specialist and inpatient care is expected to be provided, while at the tertiary and quaternary level increasingly more comprehensive care is expected (figure 2). Table 1 reveals the injury relevant services expected at various levels of the health system but also many current gaps. Patients navigate this continuum of care through different routes depending on a multitude of factors and experience barriers along the way. They

may diverge from expected routes or create new ones depending on need. ‘Care pathways are structured guidelines for the assessment, diagnosis, and treatment of patients with a given condition’ (123). NICE pathways are an example of care pathways used in the United Kingdom. A care pathway is a sequence of critical treatment events that are matched to a patient's recovery. (124) there is no expected or standard care pathway defined for Zimbabwe but the WHO has defined an expected pathway for trauma and emergency care. Health seeking behaviours and choices are the result of a complex interplay of individual, interpersonal, community and societal factors influenced by the macroenvironment. The country's recent social, political, and economic volatility has further complicated the journey in search of care. Divergence from established routes for care may lead to delayed or inappropriate care, catastrophic or impoverishing expenditures and may adversely affect outcomes. this idea of trauma care occurring along a whole or continuum is embodied in the continuum of care model that includes all aspects of the journey from the scene of injury through emergency transportation and arrival and treatment at the facility through the emergency department and admission wards, discharge, rehabilitation, and re-entry into society. This expected pathway through care for trauma is conceptualised in the WHO emergency care system framework. which brings together all of the core emergency care functions and allows policy makers to analyse where current and future gaps lie in the care continuum.

efficient, timely, patient centred, equitable and responsive to and friendly for vulnerable users such as children. It should be able to deliver a patient with a traumatic condition to the appropriate care within minutes, if necessary, within the so-called golden hour while also prioritising resource allocation and maximising clinical and patient reported outcomes.

Table 18. District core health services for Zimbabwe. Showing the services that are expected to be provided at the district level of care. (Source - ministry of health)

Level of care (category of care)	Description of Injury relevant services expected
Rural health centre and community core health services	
Promotive and preventive services	Nil
Disease Surveillance	Nil
Environmental Health Services	Nil
Outreach Services	Nil
Curative Services	
Treatment Services	Treatment of minor injuries
Minor Procedures	Suturing of minor lacerations
Rehabilitation Services	To keep a register of permanently disabled people in the catchment area
Community based Health Care Activities	
Village Community Worker/Farm Health Worker	Treatment of minor ailments/first aid
Traditional Healer	Health promotion and traditional treatment of some ailments
District Core Health Services	
Promotive and preventive services	Nil
Environmental Health Services	Surveillance of reportable and notifiable diseases (injury not included)
Health Information Management	Institute Sentinel and other types of surveillance systems
Information, education and communication	Nil
Outreach Services	School health programs
Curative Services	Accident and emergency cases
Clinical services	Burns
Procedures	Debridement of wounds and burns
	Suturing of wounds: primary and secondary
	Skin grafting
	Removal of foreign bodies from ear/nose
	Removal of other superficial foreign bodies
	Release of burn contractures
	Reduction of fractures

	Application of POP with or without manipulation under anaesthesia
	minor amputations
	insertion of Steinmann pin or K wire for skeletal traction
	Major amputation in emergency
	external fixation of fractures
	bone drilling
	tendon repair
Rehabilitation Services	

The recognition of paediatric trauma as a distinct entity with unique requirements led to the development of the concept of the paediatric trauma system. The definition of a paediatric trauma system is “an organized, coordinated effort in a defined geographic area that delivers the full range of care to all injured patients” (Fallat et al). The first dedicated paediatric trauma unit opened in 1962 and eventually the first paediatric trauma system was developed in the USA in 1983 alongside the national paediatric trauma registry in 1985 and the paediatric trauma score (PTS) in 1987.

Table 19. Core health services for Zimbabwe related to injury at different levels of care in the Zimbabwean health care system.

Beyond the clinical care continuum, a trauma system also prioritizes outreach, education and advocacy, data collection through registries, research, funding, and disaster preparedness and response

The rationale for conducting this journey mapping exercise is to identify service gaps and unmet needs, to identify delays in diagnosis, referral, and treatment and potentially inform health service redesign and improvement for injured children. We used a patient-centred approach to elicit insights from people with lived-experience of the local Zimbabwean health services to understand how to adapt them to the needs of patients. the focus on children is justified because of the relative dearth of literature on this key vulnerable group and the specific issues related to child-friendly trauma systems.

6.2 Chapter Aims

To explore the experiences and perspectives of admitted children and their families with unintentional injury and their families in Zimbabwe.

The specific objectives are to:

1. Understand and map existing care pathways through health services for injured children and their families throughout the continuum of care.
2. Identify the barriers and facilitators faced along the care journey of injured children and their families.
3. Understand whether and to what extent the current trauma care system is paediatric-friendly.
4. Understand the pertinent health care utilisation choices and reasons for these choices that injured children and families make in Zimbabwe.

6.2.1 Research questions.

1. What are the different permutations of nodes, pathways, and destinations in the patient health care journey for paediatric trauma in the public sector of Zimbabwe's health care system?
2. What are the facilitators and barriers to delivering patient-centred trauma care for children, and how might these be overcome?
3. How do children with serious trauma and their family members perceive and experience healthcare services, and in particular the referral and care pathway?

6.3 Methods

This was a qualitative study conducted at four tertiary government hospitals in Zimbabwe between November 2022 and June 2023. This study uses the pragmatic approach which

emphasises the practical application of the findings and utility for solving real world problems. The study was conducted at Parirenyatwa hospital, Sally Mugabe hospital, Mpilo central hospital and United Bulawayo hospitals.

6.3.1 Participants

Inclusion criteria for this study:

- Parents or guardians of children aged (0–18 years inclusive) at the time of injury admitted to a participating centre with trauma (top two causes of trauma i.e. burns, and road injuries) OR
- Such eligible injured children old enough to respond to questions OR
- Nurses involved in the care of injured children.

The following exclusion criteria were applied:

- Children with other causes of unintentional injury
- Children with birth injuries and iatrogenic injuries
- Intentional injuries (non-accidental injuries), or those for whom there were significant safeguarding concerns.

6.3.2 Identification, sampling, and recruitment

Participants were identified through a combination of screening of admission records and recommendations from key informants. Purposive sampling using the maximum variation approach to sampling was employed to capture perspectives from a range of injury causes, genders, ages, and times since injury. We also purposively sought out and selected several “deviant” cases where patients’ care pathways clearly diverged from the norm. We aimed to capture perspectives from different regions of the countries, diverse cultural groupings and linguistic groups and different types of family units. We sampled from each of the participating institutions. We sampled from central hospitals because of the need to capture

the whole journey up to and including the highest available level of care in the system and because trauma care and the resources to manage it definitively are concentrated in central hospitals in urban centres (119).

Potential participants were invited to take part in the study after a private conversation with parents/guardians and child in the hospital ward. Age-appropriate participant information leaflets in the local language were given to parents and children where appropriate to peruse and informed consent was obtained from the parents and assent from the children before the interview started. Two interviewers (DM and SM) conducted the interviews DM is an indigenous male clinical researcher with an MSc and SM is an indigenous female researcher and clinician with an FCS.

6.3.3 Data Collection

Data were collected through in-depth interviews with the patient and guardian/s, case note review and clinician interviews as well as two focus groups. Our interview format was based on the journey mapping methodology. “Journey mapping is a novel, patient centred approach to capturing the care experiences and trajectories of a patient population”. (126) We conducted semi structured interviews from a predeveloped interview guide where appropriate and used a modification of the Aboriginal Patient Journey Mapping (APJM) tool to map the journey of admitted patients through the health system. Interviews were conducted in English, Shona and Ndebele as principal languages depending on the patient’s language preferences and the pertinent region. The interviews were audio-recorded with the consent of the participants, and field notes were taken during the interviews to capture non-verbal cues and observations. The interview explored the following main areas: sociodemographic information, the patient journey with challenges and facilitators/enablers, health service utilisation choices and reasons, perception of risk

and possible interventions, and finally physical, emotional, relational, cultural, spiritual and medical aspects of their journey, care and experience were explored.

6.3.4 Transcription and analysis

Interviews were transcribed verbatim, translated by an independent professional translator not known to the interviewer or participants. Anonymised, translated transcriptions were thematically analysed using Microsoft excel and NVivo version 12, a qualitative data analysis software. The researcher first became familiar with the data by reading through the translated transcripts multiple times. The researcher's familiarity of the situation of injured children in Zimbabwean hospitals because of his clinical and research experience was a key factor in interpreting the information gleaned.

6.3.5 Analytical frameworks and Data Analysis

We used a combination of relevant frameworks to analyse and present the data. The WHO emergency care system framework (WHO ECS) was the major framework used along with the four-delays framework (127). This is a modification of the three delays framework originally described by Thaddeus and Maine to describe the delay in each phase of care for obstetric patients (128). This framework has been used extensively in global health literature to conceptualise delay in the health care continuum. We also used the socioecological framework to understand barriers across different levels (129) and the 5-tier health system structure for Zimbabwe as another guiding framework.

6.3.6 Patient and community involvement

A local road safety NGO staff member, and a community representative (a mother of a child burn victim) provided feedback on the study documents (patient information sheets, consent, and assent forms as well as topic guide and information leaflets). Feedback was elicited during design, implementation, and analysis phase.

6.4 Results

In total 48 people were interviewed. These included the same participants from chapter 7 (32 child/guardian pairs, 5 focus group participants and 6 nurses) as well as 5 additional medical practitioners with knowledge of patient journeys.

Table 20. Socio-demographic and clinical characteristics of study participants.

Variables	N (%)
Age of Child	
0 to 4	18
5 to 9	5
10 to 14	7
14 to 18	2
Family situation/Marital status	
Both parents together	9
Single parent	15
Single orphan	7
Double orphan	2
Number of siblings	
0 (only child)	4
1	11
>2	17
Highest education level	
Less than Primary school	13
Up to secondary school	18
Up to college graduate	1
Injury aetiology	
Burns	19
Road traffic Crash	13
Other	0
Type of Participant	
Patient/family	8
Mother	22
Father	2
Medical practitioners	5
Nurses	6
Municipal nurse	1
General ward nurse	2
Burns Ward nurse	3

6.4.1 The Patient Journey

Conventional care pathways

From discussions with health care workers, and drawing from the WHO emergency care framework, we established the expected pathway or “conventional care pathway” for injured children in Zimbabwe, shown in figure 17. The quinary level of care is not fully operationalised and none of our participants interacted with this level of care. In the conventional pathway patients travel from the scene of the injury to the first health care facility which is the lowest level facility that is closest to them. From that facility patients are referred through the health system to progressively higher appropriate levels until the final appropriate level of care is reached based on their clinical condition and receive definitive care before going to a ‘transitional home’ which is the home of a relative or friend that is closest to the central hospital and then go home thereafter.



*TH = TRANSITIONAL ‘HOME’

Figure 20. Framework for conventional patient journey modified to Zimbabwe context using the prompts and colours of the WHO emergency care system framework.

This pathway differs from the WHO framework in the addition of the “transitional home” which is similar in concept to an informal “halfway house” or “step-down facility”. This is usually the home of a member of the maternal side of the family such as a sister, aunt, mother or sister or a member of the broader community such as church. An example of this prototypical “conventional” patient journey from our participants is shown below for one of our participants (**Figure 21**).

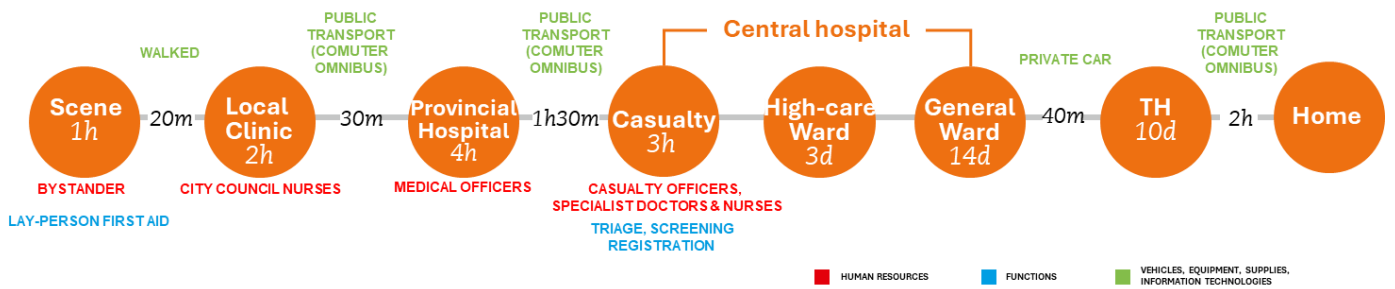


Figure 21. Patient journey (patient 3) exemplifying the conventional care pathway

Characterising divergence from expected care pathways.

Through interviews with participants, we identified several common themes in patterns of pathway divergence. In some cases, patient journeys exhibited multiple types of divergence.

Seeking alternative care

We identified participants who either preferred home-based first aid/care or alternative medicine, church or traditional healers rather than conventional allopathic medicine. Examples of this included dual care-seeking – accessing both conventional and alternative healthcare services simultaneously; dual private and public services; or switching providers. Reasons given for this are as follows:

- Lack of trust in public health care services
- Perception of delay at public facilities
- Perception of maltreatment at public facilities

“We decided to go and consult with someone influential in the community first. You know sometimes our cultural ways are best.”

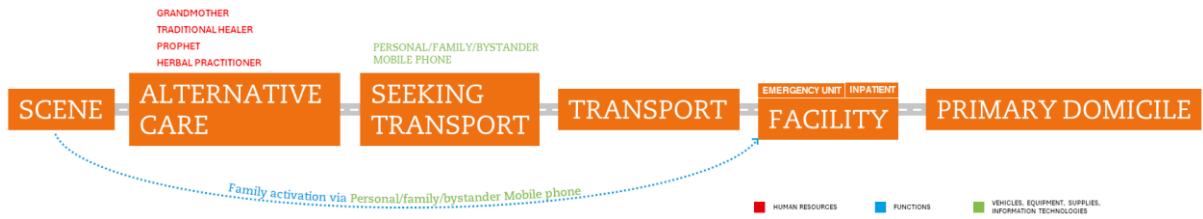


Figure 22. Framework patient journey for “seeking alternative care” prototype patient journey

An example of this patient journey from our participants is shown below for one of our participants (patient 17).

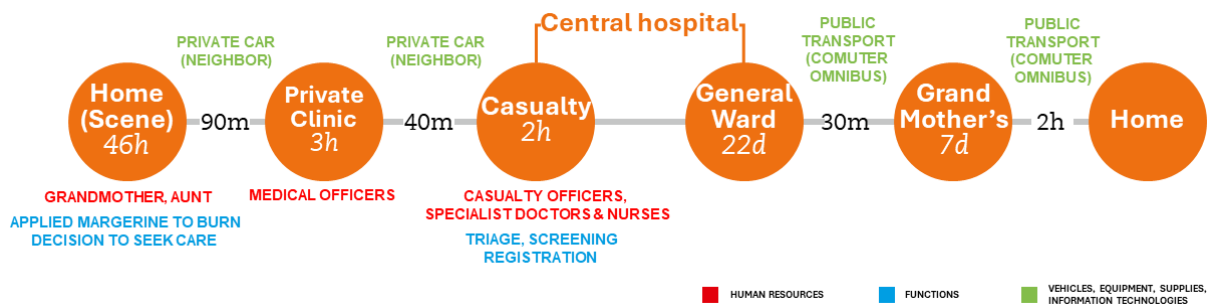


Figure 23. An example patient journey for patient 17 illustrating seeking alternative care Bypassing Intermediary Care (Self-Referral to Higher-Level Facilities)

In some situations, patients may skip primary care (or other levels) entirely and go directly to higher-level facilities bypassing established referral mechanisms. Reasons for this were:

- Perceived poor quality or lack of services at lower levels of care
- Informal payments and influence enabling access to higher levels of care directly or out of sequence.
- Cost

“When I get sick, I just go straight to the specialists because I know I will be handled well”

“Because going to other clinics there’s no point. They will obviously refer you here”
 “For me if it’s something that I can see that I will be referred to a bigger hospital I would rather come straight here because the process of being seen at the clinic then transfer it’s a long process.”

An example of this patient journey is shown below in Figure 25. In this example a patient with burns was able to go straight to the central hospital for burn injuries that may have been able to be treated adequately at lower levels of care and subsequently was discharged home early to be followed up from home.

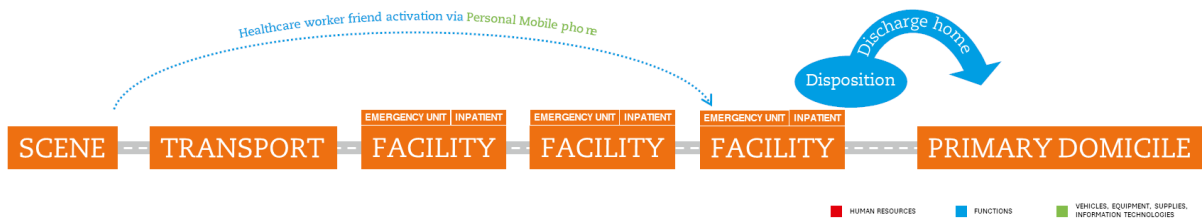


Figure 24. Framework patient journey for “bypassing intermediary care” prototype patient journey

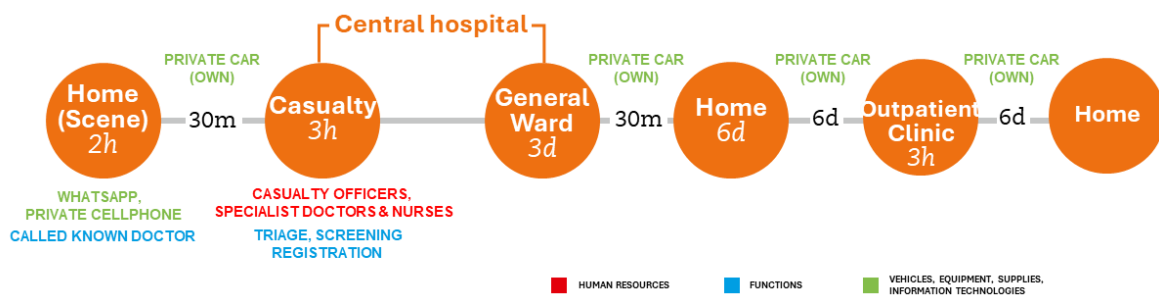


Figure 25. An example patient journey for patient 23 illustrating bypassing intermediary care.

Non-Sequential Movement Across Care Levels

This pattern refers to disruptions in the normal progression through the health care system leading to movement back and forth from facilities of the same level or retrograde

movement back to a lower level or movement from a health facility back to home and forth again. This leads to increased transport costs, frustration for patients, and prolonged delays in receiving care Figure 26.

“So, what happened is that I came back to hospital for a checkup because of a smell. The nurses didn’t really know what to do with her she was just covered up with bandages and that’s how she developed an infection.”

- Can be back and forth recursive movement or retrograde movement. (Patients may be referred from a lower to a higher level and then sent back without receiving the necessary care, possibly due to a lack of specialist availability or necessary equipment at the higher-level facility)
 - Facility Refusal to Accept Referrals: Higher-level facilities may refuse to accept certain cases due to capacity issues, resource shortages, or zoning restrictions, forcing patients to return to lower-level facilities.
 - Referred to care levels not suited to the severity of their injuries. These can manifest as either over referral or under referral and lead to delay.
- **Geographic Mismatches:** Patients might be referred to facilities that are geographically distant, even when closer options exist. This might occur because of rigid referral guidelines or the reputation of certain hospitals.

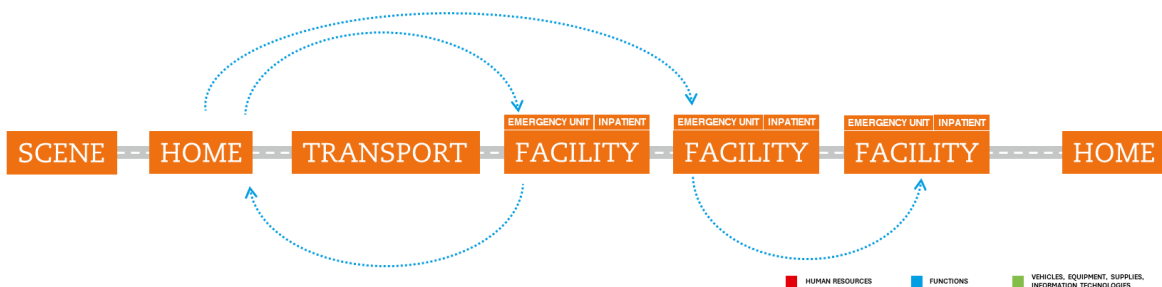


Figure 26. Framework patient journey for “non-sequential movement” prototype patient journey

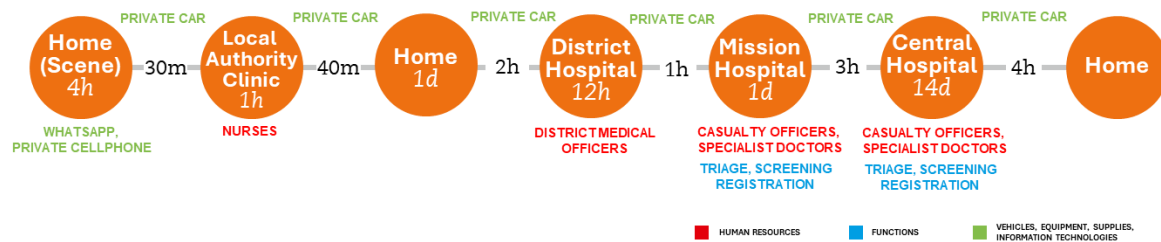


Figure 27. An example patient journey for patient 4 illustrating nonsequential movement
Delays in the care pathway

Patients may also experience delay in commencing or progressing through the care pathway. Based on the three delays framework we identified the following reasons for delay.

Delay 1: delays in initial care seeking ("wait-and-see"):

A delay from the time of injury to the point where they reach the first medical facility.

"I didn't know how serious it was at the time. Its only later when I realised something was wrong."

"We had to find money first"

Reasons for the first delay:

- Lack of awareness of injury severity
- Expectation of high costs along the way leading to complete avoidance
- High costs of transport from the scene or home
- Raising money from family, friends and community to pay for transport
- Unavailability of transport to reach initial facility
- The need to confer with senior family members (usually male) for permission to seek care
- Long wait times by ambulances

Delay 2: Health system delay:

In these cases, patients are delayed while they navigate through the health system of referrals in search for the correct level of care and definitive treatment.

Reasons included:

- Inappropriate referral or non-referral
- Delays in ambulance response between facilities
- Fear of presumed cost of care

“We were admitted to X hospital first, but I later found out that we should have been sent to the central hospital because his burns were serious.”

“It took time to get an ambulance so we could go to the next hospital.”

Delay 3: Treatment delay:

Refers to delay in receiving definitive care once patients have arrived at the final institution.

Reasons included:

- Shortage of theatre time to operate
- The need for informal payments access theatre
- Lack of equipment to use for surgical operations (implants, skin graft blades etc) and consumables (Silver Sulfadiazine cream, hydro Fiber dressings)
- Lack of money to purchase blood for transfusion or laboratory tests

“Some people have to pay someone to be put on the list for operations.”

“We have to buy medication from an outside pharmacy so the nurses can give him medication”

“They told us there is no theatre for him to be operated this week”

6.4.1.1 Barriers and enablers along the healthcare journey

Barriers and enablers along the injury care continuum were elicited from patients for each element of our conventional care pathway framework. These are summarised below and shown in **Figure 28**.



*TH = TRANSITIONAL 'HOME'

The scene

For falls and road traffic crashes, participants largely didn't attempt first aid because of fear of making things worse, fear of blood and fear of the deformity of a fractured limb.

"Eish no I didn't I was scared to do anything. The leg was bent in a scary way."

"I'm not a doctor so I don't even know where to start. I just rushed to the clinic."

However, for burns, after probing, respondents did admit to considering or trying different remedies based on availability:

"Yes, I have heard of sugar and eggs, but I didn't do it. I might have put margarine, but I didn't have any at the time. I definitely would have used it."

"I just put a little bit of margarine before we went just to improve healing."

Enquiry about home remedies, information passed down through generations or in the community revealed atypical first aid practices and many admitted to limited knowledge of first aid for burns.

Key enablers are bystanders who help to extricate victims, try to administer first aid and arrange transport and communication with family.

"[Bystanders] ran to stop the car and told him to stop because there is a child below the car."

"People then tried to lift the car, and the child crawled out from underneath, crying."

"The bystanders called his father."

Transport

Participants reported a tendency to immediately take the child to a health facility mainly spurred on by worry about the child's condition and guilt at the incident. They did experience some delay in finding transport (facilitated greatly by well-wishers from the community with a vehicle) as well as arranging money for the hospital visit, but less so in actual transit time. This is illustrated in the quotes provided below:

“All the money gets finished on the ambulance and there isn't any left for the actual treatment”

“We have to sell a cow to afford it.”

“We tried to ask and argue to try to avoid the travel because of the long travel, the cost of the ambulance and everything. We really tried to ask if there wasn't anywhere else closer where we can go. We were told no [named central hospital] is the best.”

“It is very difficult when we are in hospital far from home, we have no one to help us”

“If you are using public transport, it can take time to get there but usually once we are on the road it doesn't take time. “

Facility – Emergency department

Barriers identified here were numerous. These included multiple delays in the admission and assessment process:

“The x-ray person wasn't there as well. They came around 8pm [from 5pm] and so we had to pay for the x-ray, and we spent 2 hours trying to swipe our cards to get it. This took so long. By 11-12 midnight that's when ... we were admitted.”

Facility – inpatient

Throughout the journey a prominent theme that emerged was the substantial psychological impact of parents especially mothers and grandmothers throughout the continuum of care.

“When it happened, it was really bad I felt like I was going crazy I couldn’t control myself. I was very hurt and feeling bad.”

My family were shouting at me especially on my husband’s side saying how can you be so careless? It’s a huge challenge from my perspective because I was felling sad and angry at the same time.

“My brain was so affected at the time I couldn’t understand what the doctors or the nurses were saying to me. I didn’t know anything”

Major enablers identified here were nursing staff and other mothers who were the biggest source of support to incoming mothers particularly mothers who had been in the ward for long.

“People tried to comfort me like the nurses working at the casualty and tried to counsel me and comfort me.”

“Yeah, they [the nurses] really, really helped even financially. They would give me a dollar here or there to get medications from their pocket.

Another major barrier is the need to buy medication during admission. This includes blood products, bandages and other medication.

“The blood issue really stressed me” ... “the blood [issue is] bad. It was available but I didn’t have the money to pay for it. The challenge was about money.”

“At the [named provincial hospital] we had to drive around looking for gauze dressings, medication everything we had to buy for ourselves”

There were also challenges related to going home:

“The doctors don’t come to see him often. So, I have no one to tell that I want to go home.”



Figure 28. barriers and facilitators along the patient care journey.

6.5 Discussion

This study provides an in-depth exploration of injured children and their families' experiences navigating through the Zimbabwean trauma health system. Using a journey-mapping approach we characterised typical care pathways and identified barriers and facilitators to accessing trauma care. Our results suggest that patient journeys often diverge from the expected care pathway due to a diverse range of factors including patient choices and health system inefficiencies. These findings provide insights into potential areas for attention in improving the trauma health system and providing child-friendly trauma care.

The findings suggest that while a conventional care pathway exists, patient experiences diverge substantially. The 'conventional' pathway also differs slightly from the WHO framework. Several key typologies of divergence emerged including 'seeking alternative care', 'non-sequential movement' and 'bypassing levels of care' as well as 'delayed movement'. This type of divergence is consistent with those found in similar studies in other LMICs. In a study from northern Malawi the authors used 'four hypothetical sentinel injury scenarios' to construct health system process maps for the health system. (130) They found similar patterns of divergence from the expected pathway including delayed movement through the pathway and back and forth movement due to geographical

mismatches with patients referred to distant facilities despite closer options available.

(131)

Our findings are also consistent with previous research on the African continent that reveals multiple contextual, structural and cultural barriers to timely, appropriate and child-friendly trauma care. Real or expected financial burden shape a lot of health care seeking behaviour and movement along the care continuum. Financial barriers persisted all along the care continuum and affect all 3 of the 3 delays in the patient journey. They also presented an impediment in the form of informal payments sometimes required for expedited treatment in some hospitals system. This is similar to the experience in Malawi, (131), Rwanda, South Africa and Ghana.(132) (133) The findings on financial barriers bring up the debate on financial protection for trauma victims against out-of-pocket expenditures and catastrophic expenditures as a result of injury. The costs of injury can be considerable on a family. In a study from Tanzania as many as 73.7% of patients reported that their healthcare costs as a result of an injury were a catastrophic burden to themselves or their family while in 75% of patients the medical costs exceeded their monthly income.(134) The economic impact goes beyond the immediate costs, 40.6% of patients lost their jobs from post-injury disability while 52.9% were unable to perform activities of daily living, impacting their ability to support themselves. (134) A proposed financial risk protection mechanism, the road accident fund (RAF) has been tabled in Zimbabwe's cabinet for consideration that ostensibly would provide support from emergency care through admission and rehabilitation, (135) however this does not include protections for other causes of injury. our results show that a key facilitator for accessing injury care is the support of family and the broader community. The importance of this support is illustrated in the importance of the 'transitional home'. Patients also do not have access to this support when they are far from home if they live in areas far from the central hospital.

Other barriers identified include delays due to cultural family dynamics that require consent from the paternal family, fear of maltreatment at public hospitals and delays in ambulance response. These and other barriers were consistent with other studies in the region.

Patients with scald burns reported trying a range of unconventional first aid measures before attempting to seek care in the formal system. This is consistent with previous research from Zimbabwe (136) and other African countries, (137) (138) in which various food substances were used as first aid for burns. Food products: oil, eggs, margarine and minerals: petroleum jelly were the substances identified; however other traditional substances such as herbs, urine and dung were not identified by our participants. Patients appeared to understand however, that this was a practice discouraged by health care workers so this may have affected what was reported.

This study revealed that modes of transport between health facilities varied widely but public transport was an important mode of travel. Time taken in the patient journey appeared to be predominantly spent at each facility rather than on actual travel time, although those using public transport for long distances did report long travel times. This is important in the context of the introduction of helicopter ambulances in select central hospitals in Zimbabwe in 2024 that were expected to reduce travel times for select patients. Further research needs to be done to assess the contribution of travel time to the total time to treatment.

6.5.1 Limitations

This study was limited by the use of a facility-based study that only got insights from patients admitted to central hospitals. Thus, journey maps only included those patients who successfully reached central hospitals and excluded those who experienced barriers that prevented them from reaching the central hospitals *at all* for definitive treatment. We

intend to address this in future work that include community-based surveys. The study is also susceptible to recall bias because patients may not have recalled their entire journey or their thought process at the time. Some sensitive issues such as informal payments, perceptions of health care workers and family dynamics may have been underreported due to social desirability bias. Social desirability bias may have also affected responses related to use of traditional healers or home remedies and practices thought to be frowned upon by the medical field and criticism of health care workers or healthcare facilities. My own positionality as a healthcare worker with an established career in the country and in the sampled hospitals brings important background and contextual knowledge about patients experiences but also may lead to preconceived ideas that may affect analysis, interpretation and interview technique.

6.6 Conclusions

This study provides a comprehensive exploration of the trauma care pathway for injured children to Zimbabwean central hospitals. The study aimed to capture qualitative insights on the barriers to accessing timely, appropriate and effective trauma care for children and their families admitted at three central hospitals in Zimbabwe and to characterise patterns of movement through the health care system. The study revealed the complex and often non-linear pathways that children take navigating the health system in search for care for injuries. I identified a conventional care pathway based on the WHO emergency care framework and several patterns of divergence including “Seeking alternative care”, “Self-Referral to Higher-Level Facilities”, “Non-Sequential Movement” and “the delayed care pathway”. Children face multiple barriers along their health system journey including financial barriers, familial barriers and other sociocultural barriers that lead to delay or cause deviation from the expected pathway to care. This study provides areas for targeted

intervention to remove barriers to accessing timely care for children and improving the health system.

CHAPTER 7: Deployment of a registry tool in three Zimbabwean hospitals

7.1 Background

Our previous work established that there is a significant lack of literature on injuries in Zimbabwe, particularly childhood injuries. We have also established that there are no national or institutional trauma registries in the country based on a scoping review of white and grey literature. We learned from the experiences of trauma registries in Africa on operational and methodological as well as design aspects of a trauma registry. We also identified the design and operational issues as well as systemic and legislative factors that might facilitate or impede implementation of a trauma registry in Zimbabwe. We identified context specific risk factors for common child injuries not usually included in trauma registries and also characterised the health system movements of an injured child moving through the health system in search of care. Using these insights, we designed a bespoke trauma data collection form and process for use in Zimbabwean central hospitals. There is a gap in understanding of the flow of patients through the trauma health care system and utilisation of different levels of care for trauma. These perspectives are crucial for identifying specific pain points in the trauma health system, from pre-injury hazards and risk to emergency prehospital care, transport and appropriate referral to hospital admissions, definitive treatment, and post-discharge follow-up. Trauma care appears to still be relatively centralised with the majority of trauma care capacity (human resource, infrastructural etc) found in central hospitals (119).

We aimed to quantify identified risk factors as well as health system flows and delays for injured children admitted at three major Zimbabwean hospitals. The objectives of this chapter are to pilot a form designed using insights from the previous chapters, understand

the delays experienced by injured paediatric patients as well as the quantum of patients moving through different health system levels.

7.2 Methods

7.2.1 Study design and setting

This is a prospective observational study performed at three major hospitals in Zimbabwe between July and November 2024. Sally Mugabe Central Hospital, Parirenyatwa Hospital and United Bulawayo Hospital are three central hospitals in Zimbabwe that are specialist referral centres for childhood injuries. Zimbabwe has a pyramidal health care system with 5 levels of care arranged in a hierarchical system from primary care through quinary care as shown in the previous figure 15 above. the primary level of care consists of rural health centres, rural hospitals, a network of municipal clinics, mission clinics and clinics in the private sector. The country has 6 central hospitals in the public sector in three of the country's 10 provinces.

7.2.2 Study population, sampling and sample size

All patients aged between 0 and 19 years admitted to any of the three study hospitals between July and November 2024 with an injury were eligible for enrolment. Inclusion and exclusion criteria were as follows:

Inclusion criteria:

- Children and adolescents aged 0 to 19 years AND
- Admission to a hospital ward for an injury between July 2024 and December 2024
WITH
- The following International Classification of Diseases, 10th Revision (ICD–10) underlying cause-of-death (UCOD) codes:
 - V01–V99, W00–W19, W20–W49, W50–W64, W65–W74, W75–W84, X00–X09, X10–X19, X20–X29, X30–X39

Exclusion criteria

- Patients who met admission criteria but refused admission, absconded from hospital or left against medical advice
- Patients who refused to take part
- The following International Classification of Diseases, 10th Revision (ICD–10) underlying cause-of-death (UCOD) codes:
 - X40–X49, X60–X84, X85–Y09, Y36, Y40–Y84, Y88, T36–T50, T51–T65, Y10–Y34, Y85–Y89, Y90–Y98 (shown below in table x).
- Injuries occurring more than one month before presentation.
- Patients presenting for follow-up care.
- Cases with missing outcome data

Table 21. Inclusion and exclusion criteria by ICD 10 underlying cause-of-death codes.

Include	Exclude
V01–V99: Transport accidents (e.g., pedestrian, cyclist, motor vehicle accidents).	X60–X84: Intentional self-harm (e.g., suicide by hanging, poisoning, firearms).
W00–W19: Falls (e.g., slipping, tripping, stumbling).	X85–Y09: Assault (e.g., homicide by firearms, sharp objects, physical force).
W20–W49: Exposure to inanimate mechanical forces (e.g., falling objects, machinery accidents).	Y36: Operations of war (e.g., injury or death due to armed conflict, war-related explosives)
W50–W64: Exposure to animate mechanical forces (e.g., bites and scratches).	Y40–Y84: Complications of medical and surgical care (e.g., adverse effects of drugs in therapeutic use, surgical complications).
W65–W74: Accidental drowning and submersion.	Y88: Sequelae of medical and surgical care as the cause of subsequent injury or death.
W75–W84: Other accidental threats to breathing (e.g., suffocation, strangulation).	T36–T50: Poisoning by drugs, medicaments, and biological substances.
X00–X09: Exposure to smoke, fire, and flames.	T51–T65: Toxic effects of substances chiefly nonmedicinal (e.g., alcohol, gases, heavy metals, and pesticides).
X10–X19: Contact with heat and hot substances (e.g., burns, scalds).	Y10–Y34: Event of undetermined intent (e.g., poisoning or injury with unclear cause).
X20–X29: Contact with venomous animals and plants.	Y85–Y89: Sequelae of external causes of morbidity and mortality.
X30–X39: Exposure to forces of nature (e.g., lightning, floods, extreme temperatures).	Y90–Y98: Supplementary factors related to external causes (e.g., alcohol or drug involvement, mental and behavioural factors).

7.2.3 Identification and recruitment

Patients were identified prospectively by study staff in designated hospitals in the emergency department of the study hospitals using the casualty attendance and admission book. Study staff were medically trained data collectors who were not involved in direct care of the patients. Recruitment was performed in the wards after the immediate emergency phase of treatment by study staff who were not related to the care of these patients. Study staff were pretrained on the data collection instrument and collection.

7.2.4 Sampling and sample size

I employed a convenience sampling strategy to enrol all consecutive injured patients meeting the inclusion criteria over the study period in the three hospitals. This approach

was used to ensure an adequate number of participants. The sample size for the study was determined based on the primary outcome measure which was the mean delay in hours from injury occurrence through health system referrals to definitive treatment and after. The required sample size was calculated using the formula for estimating a population mean, as follows.

$$n = \left(\frac{Z_{\alpha/2} \cdot \sigma}{d} \right)^2$$

n = required sample size

$Z_{\alpha/2}$ = normal value for the chosen confidence interval = 1.96

σ = assumed standard deviation of the delay in hours = 4 hours

d = Margin of error = 1 hour

$$n = \left(\frac{1.94 \times 4}{1} \right)^2$$

$$n = (7.84)^2$$

$$n = 61.46$$

= sample size of 62 minimum patients required

7.2.5 Data collection and storage

Data was collected using a 2-page, 75-item paper-based trauma documentation form developed using information from previous chapters. Data was collected after the initial emergency patient contact in the wards and not in the emergency department. This was done to avoid the physical and psychological impact of the emergency situation that participants told us would hinder reliability of the data collected.

7.2.6 Definitions of time intervals

We used a conceptual hierarchical framework for hospital health system level namely: primary, secondary, tertiary, quaternary levels. A quinary level exists in Zimbabwe however none of these hospitals were operational during the time of the study. Hospital level was defined using the sub-Saharan facilities list for public healthcare facilities. (64)

The time period in the patient journey from injury event to definitive management was split into three-time intervals using a modification of Three Delays Model. We defined the following: care-seeking interval, health-system interval and treatment interval. The care-seeking interval was defined as the time in hours from the time of injury event to the date of first contact with the health system at a conventional medical institution. The health-system interval was defined as the time between first contact with the health system until the date of admission to one of the study site hospitals. Treatment interval was calculated as the time in days from the date of admission at a central hospital to the date of definitive management. Definitive management for patients with fractures was defined as receiving a surgical operation or application of plaster of Paris. For burns this was defined as commencement of dressings and/or skin graft for deep burns. Total time to hospital (TTH) was calculated as the time in hours from the injury event to the date of admission at the final central hospital. Total time to treatment (TTT) was calculated from the date of symptom onset to date of definitive treatment.

7.2.7 Statistical analysis

Descriptive statistics were used to describe the demographic characteristics of participants, and the patient journey time intervals, patient flows and variable completion rates for the data collection tool. Sample medians, and interquartile ranges were calculated for each interval. I used inferential statistics to assess whether time intervals for different pathologies differed from each other.

7.2.8 Ethics

This study was conducted under ethical approval from the participating centres, the Sally Mugabe Central Hospital Ethics Board (SMCHEC80422/57), the Joint Research Ethics Committee (221/2022), and the Oxford Tropical Research Ethics Committee (543-22).

7.3 Results

7.3.1 Characteristics of patients

Over the study period, a total of 103 patients were admitted for injuries in our study hospitals. 97 of these patients gave consent to be included in this study.

Table 22. Characteristics of patients aged 0 to 19 years admitted for injury in three Zimbabwean hospitals.

Characteristic	Frequency (%)
Age	
0 – 4	5 (5.2%)
5 – 9	30 (30.9%)
10 – 14	25 (25.8%)
15 – 19	22 (22.7%)
Missing	15 (15.5%)
Gender	
Male	57 (58.8%)
Female	35 (36.1%)
Missing	5 (5.2%)
Cause of injury	
Burns	30 (30.9%)
Falls	13 (13.4%)
Road traffic crash	47 (48.5%)
Bites	4 (4.1%)
Missing	3 (3.1%)

Time intervals in the patient journey of injured children

Median care-seeking interval, health-system interval and treatment interval were 1 hr 40, 2 hr 30 and 3.1 days respectively. The median care seeking interval for burns was higher than for fractures and visceral trauma, respectively: 2 hr 00, 1 hr 20 and 1 hr 00 ($p < 0.05$).

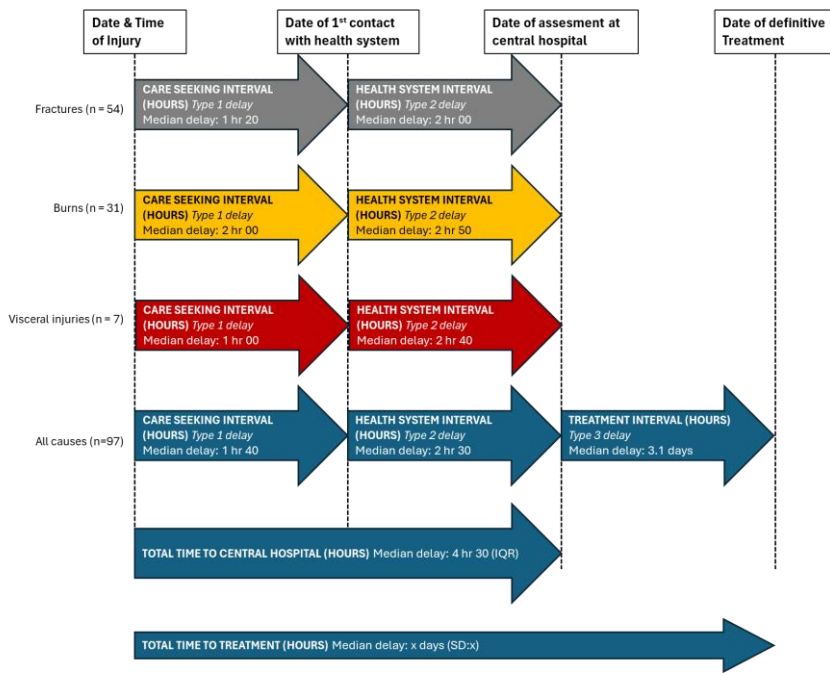


Figure 29. time intervals in the patient journey to treatment for trauma

We visualised flows of patients through various health system levels and types of institutions using a Sankey diagram below (Figure 30). Sankey diagrams show the *flow* of resources between successive *nodes*.

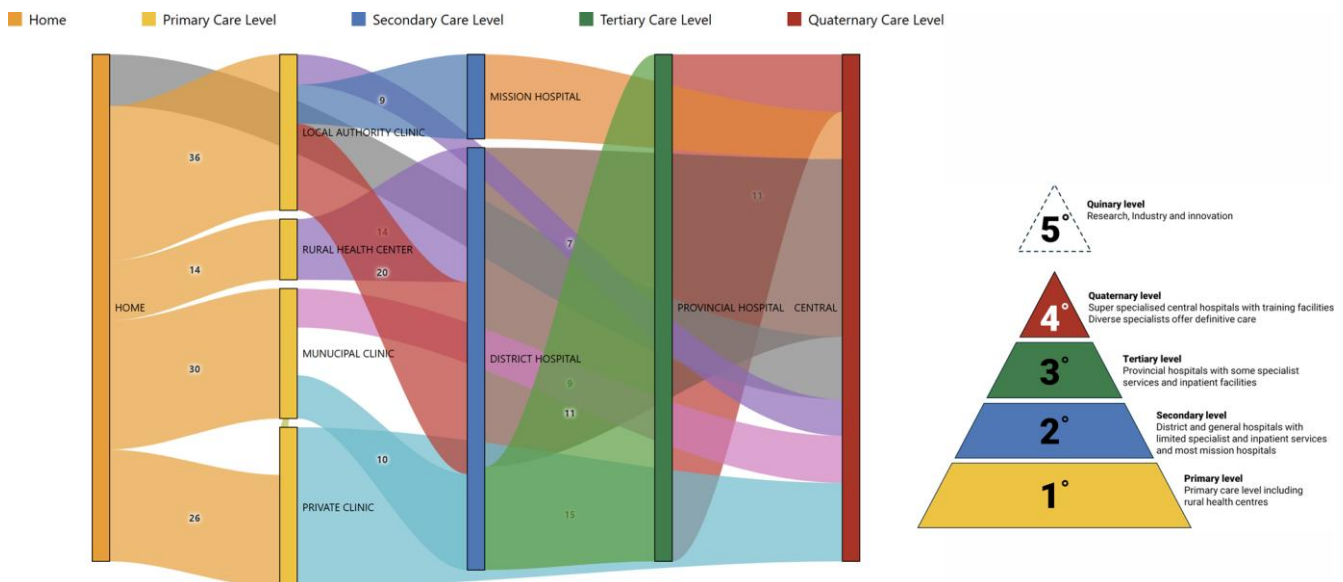


Figure 30. Treatment seeking of injured children aged 0 to 19 years admitted at three central hospitals for treatment. (Sankey diagram)

Table 23. Completion rate of key variables

Variable domain	Variable	Completion rate
Patient registration	Case ID	100%
	Health facility	100%
	Surname	100%
	First name	100%
	Hospital no	95%
	Gender	95%
	DOB	90%
	Age	93%
	Age grouping	34%
	Patient residence	63%
	Phone number (Tel)	73%
	Phone number (WhatsApp)	65%
	Parent/guardian/relative name	45%
	Relationship to patient	41%
Initial Clinical condition	Arrival date	91%
	Arrival time	87%
	Number of prior facilities	3%
	Referring facility level	34%
	Facility arrival mode	57%
	Signs of life	2%
	First vital sign assessment time	2%
	Pregnant?	6%
	Initial heart rate	5%
	Initial SBP	16%
	Initial AVPU	3%
	Initial O2 sat	12%
	On oxygen?	23%
	Initial resp. rate	9%
	Initial GCS: Eye	4%
	Initial GCS: Verbal	4%
	Initial GCS: Motor	3%
	Major medical comorbidities	2%
Details of injury	Intent of injury	45%
	Alcohol use	3%
	Drug use	1%
	Details	1%
	Cause of injury	97%
	Pathology	83%
	Activity when burnt	96%
	Boiled water on	96%
	Burn %	67%
	Power cut during burn?	56%
	Was child supervised?	67%
	Area of body injured	87%
Emergency unit details	Area of body injured	75%
	Emergency unit interventions	32%
	Casualty departure date	56%
	Casualty departure time	56%
	Disposition	45%
Socioeconomic information	Patient/guardian occupation	54%
	Medically insured	34%

	How many rooms do you use	24%
	Highest level of school #1	45%
	Highest level of school #2	40%
	Where is cooking done	76%
	Water temperature	72%
	Main source of water for cooking/bathing	85%
	What type of fuel is used for cooking	85%
	How does your child get to school	875%
Final outcomes	Alive	65%
	Length of hospital stay	78%
	Final diagnosis	76%
	Final disposition	84%

7.4 Discussion

In this pilot study we deployed a bespoke trauma registry instrument in three Zimbabwean hospitals. This provided insights into the implementation of the tool and its usage as well as patterns of referral and delays in the patient journey. This study demonstrates that while the registry effectively documented delays in the health system journey there are still critical gaps in documentation of vital signs and detailed information on the events in the emergency room.

The completion rate of variables reveals some patterns of difficulty of implementation. Variables related to initial assessment of the patient including vital signs and emergency unit details were very poorly recorded despite training of data collectors on their importance. This may have been due to the previously identified barriers from chapter 4. Recording of variables is affected by limited availability of measuring equipment in the emergency department. This is a major barrier to collection of important data useful for quality improvement in the emergency department, calculation of physiologic injury severity scores and various other important outcome measures. The completion rate of vital signs compares unfavourably with similar research from Botswana which recorded completion rates of 92.3%, 89.2%, 89.2%, 73.7% for heart rate, systolic blood pressure, diastolic blood pressure and oxygen saturation respectively. (139) These variables are not only important for the registry but also for clinical decision-making in the emergency

department. Variables for health system movements are markedly better documented in this study for example the level, name and transport mode to each successive health facility were well documented. A change to concurrent data collection with provision of the relevant measuring equipment would help improve the completion rates for these crucial variables. Another recent study from Tanzania had more comparable overall completion rates for vital signs than in our study: initial heart rate, initial systolic blood pressure, respiratory rate and oxygen saturation were completed in 24.2%, 18.4%, 17.6% and 13.0% respectively. (140) Documentation rates for individual hospitals reached as low as 0.2% in a regional hospital for oxygen saturation. They similarly attributed this to lack of key resources such as cardiac monitors or a pulse oximeter, and increased patient workload. (140) In fact incomplete documentation of vital signs is quite common in Africa emergency departments, while AVPU and Glasgow coma score were almost never documented. (141) Further work must be undertaken to improve the documentation of key variables beyond the implementation of trauma registries. Across all studies, demographic information is the best-documented group of variables. (139–141)

Based on the limited utility for measuring actual socioeconomic status and poor documentation rates of variables such as patient guardian occupation and highest educational level, an argument may be made for these variables to be discarded to simplify the form or replaced by better measures such as the MacArthur Ladder score. (142)

We used available data to map delays across the patient journey using the 3 delays model. We noted that the care-seeking interval was the shortest interval, followed by the health system interval and treatment interval.

Limitations

This pilot study was limited by selection bias. In this case, the inclusion of patients from central hospitals necessarily means that it missed out on those who decided against or were unable to reach these hospitals. Therefore, these results should not be taken to be representative of the entire Zimbabwean health system and only illustrative of events as they relate to the central hospitals in question.

7.5 Conclusion

In this study, I piloted a bespoke trauma registry instrument across three Zimbabwean central hospitals, providing critical insights into feasibility and data quality considerations. My findings highlight delays along the health care journey for injured children, with the greatest bottlenecks occurring during referral within the health care system rather than with care-seeking behaviour. Referrals from a variety of primary care facilities mostly occurred through secondary-level facilities such as district hospitals, while municipal and local authority clinics emerged as a key potential initial resource for the care of injured children. The registry effectively documented patient flows through the health system as well as time delays in the patient journey, demonstrating its potential as a tool for mapping utilisation of the trauma health system and informing policy to optimise service delivery in Zimbabwe. Targeted interventions to improve capacity at secondary and tertiary care levels could enhance trauma management at these levels of care, freeing up capacity at the central hospitals and improving overall system and allocative efficiency. Challenges remain, however, with regard to data completeness, especially in the documentation of vital signs, assessment and interventions in the emergency department, which are crucial for quality improvement in the emergency department. The low completion rates for these variables despite the training of data collectors suggests systemic and institutional factors

hinder data entry and agree with the findings of the previous qualitative study on the barriers that exist.

This study represents a foundational step in establishing a trauma registry in Zimbabwe providing valuable perspectives on utility of a trauma registry and highlighting challenges for data collection quality and completeness. By addressing the identified challenges, Zimbabwe can strengthen trauma surveillance and begin the process of developing data driven policies and interventions for reducing the burden of injuries.

CHAPTER 8: Discussion & Conclusions

8.1 Discussion

This thesis provides a comprehensive analysis of trauma surveillance in Zimbabwe and the burden of injuries in the country, the state of trauma registry design, implementation and operation in Africa and the challenges and opportunities for the implementation of a trauma registry in Zimbabwe. I identified contextual risk factors for the most common childhood injuries in Zimbabwe and potential mitigation interventions. Through a multimethod approach, I characterised different typologies of patient journeys for injured children attending central hospitals in Zimbabwe, identified barriers and enablers along the health system journey and quantified the delay in accessing care for injuries in Zimbabwe as well as understanding the flow of patients through various health system levels. While individual chapters have explored these aspects in depth, this chapter synthesises key insights, putting them in the broader global health context and providing actionable insights for policy and practice.

The overall aim of this work is to catalyse trauma health system and care improvements in Zimbabwe. We uncovered critical gaps in the adequacy of trauma surveillance in Zimbabwe with a dearth of research providing reliable estimates for use in data-driven policy. This data deficit may affect the true estimates of injury in the country as well as the relative ranking of injury as a cause of death. This in turn may affect prioritisation of health conditions. Injuries are the leading cause of mortality in the 5-to-25-year age group but are not the top priority for intervention in this age group in the Zimbabwean National health strategy. (43) this may be due to underappreciation of the importance of injury. This thesis found no currently operating trauma registry in the country as well as no population-based surveillance of injuries. Surveillance of injuries national level should use both methods which are different but complementary. Facility-based registries provide granular

data that pertains to health service utilisation and treatment while population-based surveys benefit from wide coverage and national representativeness. The demographic and health survey has an “Accident and Injury Module” that is currently optional for use by DHS countries and has had limited usage thus far. (37) This represents the best available representative survey. The next version of the Zimbabwe DHS has begun collecting data from this optional module and this data should be available in the coming years for analysis. The implementation of a trauma registry in Zimbabwean health care facilities is urgently needed for near real-time care and outcomes tracking. This work identified opportunities for trauma registry integration. The variables of the WHO standardised clinical form have already been entered as fields in the existing EHR (Electronic Health Record) known as Impilo as a module within the system which is a key facilitator for future implementation of the registry in a way that is integrated with the current system. Our study also identified a potential cadre of health care workers who are already rotating within the public hospital system who can potentially take over operation of the trauma registry. These two potentially mitigate against two key barriers to trauma registries that have been identified repeatedly in the literature from LMICs. (78) (26,72) In turn the integration with existing systems and use of existing human resources will help potentially solve the biggest identified barrier from this study, data sovereignty and the need for control of injury data within the government system. The revelation of how important data sovereignty is as a barrier is a potentially novel finding that may be the lynchpin for trauma registry implementation in other countries. A potential route to implementation in Zimbabwe it to use one sentinel hospital for implementation to demonstrate the utility of a registry. Through a scoping review of African trauma registries, we also produced a long list of variables frequently used in registries on the African continent. In future work this list will be used to produce a consensus African trauma registry for paediatric trauma. This

will utilise a modified Delphi methodology among experts in paediatric trauma, paediatric surgery and trauma surveillance. Unique variables that might be useful include variables to collect data on paratransit vehicles, indigenous alcohol and other substances, socioeconomic status and age and weight appropriate vital signs.

In chapter 5, we sought to identify contextual risk factors for common injury types in children. We identified multiple risk factors from individual behavioural and environmental to systemic factors for burns and road traffic crashes as well as suggested interventions for them from the patient and healthcare worker perspective. Tailored interventions for injuries in high income countries have successfully reduced the incidence of various injuries in previous decades, however current lists of best-practice evidence-based injury prevention interventions are not applicable to the context represented in this study e.g. smoke alarms, tap water temperature legislation, playground standards and stair gates etc. The impact of legislation regulating tap water temperature for example has had a significant albeit inconsistent effect on scald burn incidence in some countries. In Ontario such legislation led to a significant decrease in age-standardized ambulatory scald cases, (143) and similarly in Washington state. (144) Relatively fewer people in Zimbabwe have access to hot water from a tap (145) and the majority of burns occur from hot water in a pot or bucket therefore legislation regulating tap water temperature may have limited effectiveness. Therefore, tailored interventions may be needed to see similar reductions. Participants suggested a number of solutions such as context appropriate childproofing measures to impede access of dangerous items to walking and crawling children, banning of dangerous heating equipment such as immersion heaters or engineering thermostatic cutoffs to limit temperature in heating buckets.

The findings suggest several policy and practice implications. The first is they provide data for development of potential bespoke, community driven home-based interventions.

Policymakers and non-governmental organisations contemplating injury prevention programs in the country should develop interventions that reflect the unique risks in the target communities. They also highlight possible opportunities for regulatory reform in the LPG industry and road safety to improve safety. Unsafe equipment may be making its way to market and contributing to injury risk. Our findings highlighted knowledge gaps for injury prevention, hazard identification and mitigation. The study also highlights the potential influence of systemic economic factors and household deprivation on injury risk. The findings of this study may also be used in the development of a home hazard assessment tool or community-Based Home Injury Risk Assessment tool for Zimbabwe.

In chapter 6 we characterised the patient journey for children accessing trauma care, tracing their path through the care continuum until treatment and discharge from central hospitals. We identified the “transitional home” as a key enabler for access in the conventional and divergent pathways alike providing financial, pastoral and childcare support for the parents and families of injured children. This is particularly important for people from areas remote from the central hospital who do not have family close by. Patients tend to pass through the transitional home on their way to the final hospital or pass through after discharge to allow for review for days to weeks before returning to the principal domicile. To our knowledge this has not been fully characterised in the literature. This shows the importance of the maternal family in providing support for families in times of illness. The literature reveals that discharge process is often not responsive to the needs of the child of family. (146) This transitional period is a period of increased vulnerability from a physical, financial and sociocultural perspective which patients mitigate through community and family help if this is available. Without it, it can be very difficult to go home let alone to return for a post discharge review. Designing housing and financial support interventions for admitted and discharged families (such as ‘Ronald

McDonald Houses' or halfway houses) and designing discharge care plans that allow for review in a secondary or primary care facility closer to home are potential ways that this burden can be alleviated. We also characterised the way in which care pathways often diverge from the expected route. Inefficiencies in referral rules and processes appear to be common and can lead to overutilisation of the highest levels of care and underutilisation of the lower levels for minor forms of injury. This was evident for minor malaria and pneumonia care as far back as 1998. (147) Minor injuries amenable to care at lower levels are common and efficient allocation of resources to these levels with diversion of patients with appropriate severity of trauma may take pressure off from central hospitals that are often overburdened. The municipal/local authority health system which comprises hospitals, clinics and polyclinics throughout the country are well placed throughout the country and are a potential asset for focusing minor trauma care in the primary care level, however this system has declined in recent years. (148) Zimbabwe has had a concentration of health care resources and capacity in central hospitals in urban areas that has only worsened over time. (149) There are inadequate primary and secondary health care facilities in both rural and urban areas (43) and the provision of trauma and surgical care is limited in these lower levels. (119,149) The national health strategy also mentions "Establish new health infrastructure to serve underserved areas, prioritizing primary and secondary care" as one of its strategic interventions. (43) Capacitation of primary and secondary health care facilities is warranted to take up their role in the management of trauma. The so-called "inclusive trauma systems" in which all hospitals provide trauma care according to their capacity and level of care have demonstrated better overall mortality and more efficient hospital utilisation than exclusive systems (where care is confined to limited, highly specialised centres). (36) (150)

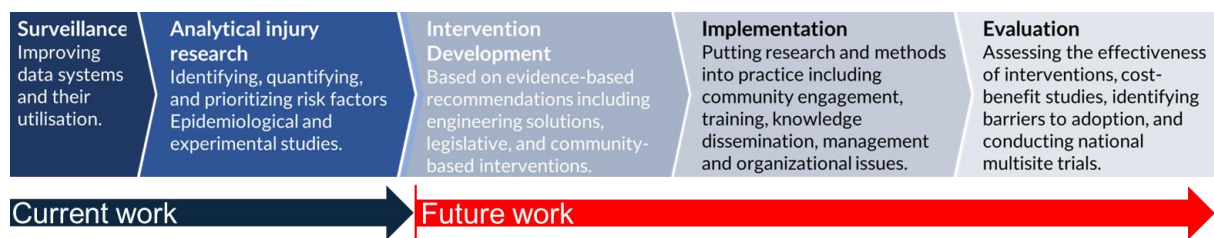
8.2 Conclusion

This thesis set out to address the critical gap in injury research in Zimbabwe and begin the initial steps of the public health response to injury prevention in the country with a particular focus on children and adolescents. Through a process of systematic enquiry, I have provided useful insights into the burden of injuries in Zimbabwe and the state of trauma surveillance in the country. This work then used the experience of trauma registries in Africa to design a bespoke registry for Zimbabwe and also investigated the contextual barriers and enablers for implementation of a trauma registry in Zimbabwe through qualitative enquiry from a broad group of stakeholders. Then I identified contextual risk factors and (potential mitigating interventions) for burns and road traffic crashes from the perspectives of admitted children and their families as well as health care workers. The work also mapped the journeys of injured children and their families through the health system, characterising distinct topologies of care pathways and eliciting the barriers and facilitators experienced by injured children as they navigate this system. Finally with the experiences of the previous work we piloted a trauma registry for in three central hospitals to quantify risks identified and understand the delays experienced as well as the referral flows.

8.3 Current and future additional work

This work is the beginning of a long program of work whose ultimate aim is to reduce the burden of injuries in Zimbabwe by 2030 (aligned with the SDGs) and beyond. The overall framework I used to achieve this is the public health response to injury prevention described earlier and repeated here. Therefore, in this work I sought to understand the state of trauma surveillance in Zimbabwe and recommend future actions for strengthening it as well as identifying and quantifying risk factors through epidemiological and qualitative

studies and suggesting potential intervention strategies. The subsequent stages of the public health approach to injury will be undertaken during an already funded NIHR project in Zimbabwe and Tanzania (see figure below) that aims to improve surveillance of injuries, develop and test an intervention for primary prevention of road injuries in children using the safe systems approach, understand the cost of trauma care in the health system and train health care workers in management of trauma cases.



On improving trauma surveillance and resultant literature one major source of upcoming injury data for Zimbabwe is the “Demographic and Health Survey” for Zimbabwe 2024/2025 for which is currently being collected and for the first time the optional “Accident and Injury” module has been added to the data collected for Zimbabwe. This will provide the best available nationally representative data for injuries in the country and will be a major boost to policymakers. I intend to analyse this data when it becomes available. While not perfect the Accident and Injury module provides good quality nationally representative data, however this data has only been collected in 8 countries so far and published in less. Advocacy for inclusion of this optional module as a mandatory module is crucial to improve the availability of injury data which is currently sparse. (37) I have been involved in advocacy for better global-level indicators for childhood injury and developed a set of indicators for child unintentional injury that should help to improve data collection and reporting on child injuries globally. (73)

In chapter 2 we conducted a scoping review of trauma registry literature in Africa. This work has been designed to lead onto two future pieces of work. The first is the

development of a reporting guideline for trauma registry data for the EQUATOR network. A proposal for development of this work has been drawn up and an application is imminent. The proposed reporting guideline will be called the “Trauma Registry Universal Standards for Transparency, Evidence, and Documentation (TRUSTED)” guidelines. This process involves an initial scoping review, a modified Delphi process and consultation of a central steering committee to develop a guideline for adequate reporting of trauma registry literature. These will likely be designed as an extension to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline. The second piece of work that will come out of chapter 2 is the development of a consensus trauma registry for childhood injury in Africa under the auspices and in collaboration with the Pan African Paediatric Surgical Association (PAPSA). Recalling that our work produced a long list of variables from trauma registries in Africa. Through a modified Delphi process I am currently in the process of developing a consensus trauma registry based on my systematic review. Through consultation with an international working group of experts and successive rounds of the Delphi process I will develop a core dataset, expanded dataset and data dictionary for use in African hospitals. This work will be completed in the next few months and will be presented at the 2025 congress of the South African Association of Paediatric Surgeons (SAAPS) in East London in May 2025 and at the biannual conference of the Pan African Paediatric Surgical Association (PAPSA) congress in Cote d’Ivoire in May 2025.

From my qualitative study on risk factors for burn scald injuries the potential for power cuts or load shedding as a cause or risk factor for burns was brought up. This has not been conclusively proven in Zimbabwe however there is some evidence to suggest this is true in the Western Cape. (97) there have been two major periods of load shedding in Zimbabwe over the last decade for which data is available. These are: in 2019 and in 2021. I intend to

perform an ecological study using geographical load shedding data from the national electricity provider and the home address of burns admissions from the same period using non load shedding periods as controls.

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Appendices

9.1 Appendix 1

Data sources used for GBD 2021 for Zimbabwe injury morbidity and mortality estimates.

Purpose	Institution	Population represented	Data collection method	Age range	Citation
Cause of death estimation	National Health Information & Surveillance Unit, Department of Epidemiology and Disease Control, Ministry of Health & Childcare	People registered in civil registration system	Facility inpatient data	Under 5 years; over 5 years	MoHCC (Zimbabwe Ministry of Health and Childcare). (2014) The National Health profile 2014 Report. Harare, Government of Zimbabwe. MoHCC (Zimbabwe Ministry of Health and Childcare). (2013) The National Health profile 2013 Report. Harare, Government of Zimbabwe. MoHCC (Zimbabwe Ministry of Health and Childcare). (2012) The National Health profile 2012 Report. Harare, Government of Zimbabwe. MoHCC (Zimbabwe Ministry of Health and Childcare). (2011) The National Health profile 2011 Report. Harare, Government of Zimbabwe. MoHCC (Zimbabwe Ministry of Health and Childcare). (2010) The National Health profile 2010 Report. Harare, Government of Zimbabwe. MoHCC (Zimbabwe Ministry of Health and Childcare). (2009) The National Health profile 2009 Report. Harare, Government of Zimbabwe.

	Registrar General's Department (Zimbabwe), Zimbabwe National Statistics Agency.	Contains tabulations on deaths in all 10 provinces.	Censuses, surveys, and facility inpatient data.		Zimbabwe Mortality Report 2007
	World Health Organisation.	Nationally representative	Cross-sectional household and individual interviews	All age groups	Zimbabwe World Health Survey 2003
	Raleigh, Clionadh, Andrew Linke, Havard Hegre and Joakim Karlsen.	Nationally representative			Armed Conflict Location and Event Dataset, Realtime. Journal of Peace Research 47(5), 651-60.
	Oslo, Norway: Peace Research Institute Oslo (PRIO), 2009.	Nationally representative			Battle Deaths Dataset Version 3.1, 2009.
	Centre for Research on the Epidemiology of Disasters (CRED)	Nationally representative			The OFDA/CRED International Disaster Database.
	World Health Organization (WHO)	Nationally representative			Global Status Report on Road Safety 2009
	National Consortium for the Study of Terrorism and Responses to Terrorism (START).	Nationally representative			Global Terrorism Database.

	International Organization for Migration (IOM)	Nationally representative			Missing Migrants Project 2014-2020.
	Department of Peace and Conflict Research, Uppsala University.	Nationally representative			UCDP Georeferenced Event Dataset, Version 17.1, 2016.
	United Nations Office on Drugs and Crime (UNODC).	Nationally representative			United Nations Office on Drugs and Crime Global Study on Homicide 2011.
	United Nations Office on Drugs and Crime (UNODC).	Nationally representative			United Nations Surveys on Crime Trends and the Operations of Criminal Justice Systems 1970-2006 as provided by Kavi Bhalla.

9.2 Appendix 2

Published sources reporting injuries in Zimbabwe.

Type of source	Author-Year	Title	Period	Coverage	Notes
Global estimates					
WHO report	WHO, 2013-2023	Global status report on road safety	2010, 2013, 2015, 2018, 2021	Nationally representative	Provides reported and modelled estimates for road accident deaths
WHO report	WHO, 2014	Global status report on violence prevention 2014	2014	Nationally representative	Provides reported and modelled estimates for homicide and interpersonal violence
WHO Estimates	WHO, 2018	World Health Estimates	2000-2018	Nationally representative	Provides modelled estimates for deaths due to all diseases
Local Statistics					
Police data	Traffic Safety Council of Zimbabwe, 2021	Traffic Safety Council of Zimbabwe 2021 Annual Report	2021	Nationally representative	Provides annual statistics of deaths due to road crashes from police and crime records
Mortality data	Ministry of Health	National Health Profile	2009 – 2014	Nationally representative	Provides annual statistics of deaths due to different causes of death including injuries
Municipal statistics	City of Harare Health Department	Harare City Council Health Department - Annual Report	2000 – 2021	Regionally: Representative?	Could not access
Municipal statistics	City of Bulawayo Health Department	Bulawayo City Council Health Department - Annual Report	2000 - 2021	Regionally: Representative?	Could not access
Epidemiological studies					
Published research article	Muchatuta et al, 2022	Emergency Medical Services (EMS) Utilization in Zimbabwe: Retrospective Review of Harare Ambulance System Reports	February 2018 – March 2019	Harare (regional)	
Published research article	Kyei et al,	Ocular trauma among patients attending a tertiary teaching hospital in Zimbabwe.	January 2017 and December 2021	Single hospital site	

Published research article	Singo et al,	Accidents, Injuries, and Safety among Artisanal and Small-Scale Gold Miners in Zimbabwe.	November to December 2020	Regional – not representative	
Published research article	Dube et al,	Follow-up CT Imaging in Patients with Traumatic Brain Injury in Zimbabwe.	2019	Single facility site	
Published research article	Chikanya et al,	An assessment of risk factors for contracting rabies among dog bite cases recorded in Ward 30, Murewa district, Zimbabwe.			
Published research article	Chimamise et al	Factors associated with severe occupational injuries at mining company in Zimbabwe, 2010: a cross-sectional study.	January 2008-April 2010	Facility – mining company	
	Tagwireyi et al	Snakebite admissions in Zimbabwe: pattern, clinical presentation and management.			
Published research article	Gonese et al	Factors associated with occupational injuries at a beverage manufacturing company in Harare, Zimbabwe--2008.	2008	Single facility – company	
Published research article	Dyer et al, 2008	Zimbabwean doctors see big rise in cases of trauma in wake of political violence.	2008	Nationally – not representative	A report of cases of injuries without clinical data
Published research article	Muguti et al,	Management of snake bites.		Single hospital site	
Published research article	Madzimbamuto et al	A hospital response to a soccer stadium stampede in Zimbabwe.			
Published research article	Tagwireyi et al,	Routine prophylactic antibiotic use in the management of snakebite.			
Published research article	Mzezewa et al	A prospective study of suicidal burns admitted to the Harare burns unit.	2000	Single Hospital site	
Dissertation - unpublished	Mbanje et al, 2017	Surveillance Of Trauma Related Admissions at A Central Hospital: Incidence and Outcomes	1st November 2014 and 28th January 2015	Single Hospital site	Studied outcomes of patients involved in motor traffic crashes. Excluded children
Dissertation - unpublished	Mzezewa S	Burns in Zimbabwe	2000-2003	Harare burns units – not nationally representative	Studies risk factors, causes, magnitude and outcomes of burns in

Dissertation - unpublished	Chikwanha TM 2010	Factors associated with accidental burn injuries in children twelve years and below admitted at Chitungwiza and Harare central hospital	May 2010 to July 2010	2 hospitals – not nationally representative.	
Dissertation - unpublished	Chirunga GM, 1995	Causes and prognosis of operating eye injuries resulting in hospitalisation at Sekuru Kaguvi eye unit		Single Hospital site	Anatomical region specific
Dissertation - unpublished	Chistika E, 2000	Pattern of chest injuries at Harare and Parirenyatwa central hospital, Zimbabwe, a prospective study		2 hospitals – not nationally representative.	
Dissertation - unpublished	Epee E, 2001	Occupational eye injuries as seen in Harare.		2 hospitals – not nationally representative.	
Dissertation - unpublished	Kamanda PC, 2002	Pain control knowledge and perceived pain in hospitalised patients with femoral fractures at Harare central hospital		Single Hospital site	
Dissertation - unpublished	Mashayamombe S, 1994	Factors associated with domestic injuries in under five in Zimbabwe: findings in three districts in the east central part of the country		Regional - representative	
Dissertation - unpublished	Mashizha S, 2013	The prevalence and factors associated with gender-based violence among Zimbabweans deported through Beit bridge district, Matabeleland south province, Zimbabwe, 2013		Regional - representative	
Dissertation - unpublished	Mhishi TW	Epidemiology of blunt abdominal trauma		Single Hospital site	
Dissertation - unpublished	Mutisi J, 2006	The relationship between implementation of discharge plan and mobilising of adult clients recovering from fractured tibia and fibula			
Dissertation - unpublished	Basera C, 2005	Factors associated with the occurrence of road traffic accidents in the city of Harare, Zimbabwe.			
Dissertation - unpublished	Mutwirah, T. 2004	Penetrating abdominal injuries		2 hospitals – not nationally representative.	

9.3 Appendix 3

Potential sources to augment injury data in Zimbabwe.

Type of source	Author-Year	Title	Period	Coverage	Notes
Census	Zimbabwe Statistics Agency 2022	National Census 2022 Zimbabwe	2022	Nationally representative	Has an injury module that could potentially collect data and inform estimates
Household surveys	Zimbabwe Statistics Agency	Demographic and Health Survey 2015	1988, 199, 1999, 2005, 2010, 2015	Nationally representative	Has an optional injury module that can be added to the questionnaire to collect injury information
Disease registries	Sibindi et al, 2020	Population characteristics, outcomes, and center-wide insights of the Zimbabwe national experience with the SIGN intramedullary nail (2013-2020).	2013 – 2020	Nationally representative?	Does not collect trauma patients rather surgical experience with a medical device.
Municipal statistics	City of Harare Health Department	Harare City Council Health Department - Annual Report	2000 – 2021	Regional: Representative?	Could not access
Municipal statistics	City of Bulawayo Health Department	Bulawayo City Council Health Department - Annual Report	2000 - 2021	Regional: Representative?	Could not access

9.4 Appendix 4

Full text screening guide used during the scoping review.

Key question	Details
Q1. Does the study pertain to injury/trauma?	<u>If yes continue to next question. If not exclude d/t ‘does not concern trauma’</u>
Q2. Are there real patients who have been affected by trauma?	<u>If yes continue to next question. If not exclude d/t ‘no primary data collected’</u> <i>Je exclude those that talk about issues around injury registries such as qualitative studies, implementation, systematic, narrative, scoping reviews, case reports etc.</i> <i>Note: if the study does not have real patients but does describe elements of the registry that relate to subsequent publications, set the paper aside and add the letters ‘QL’ to the file name.</i>
Q3. Is the data from a trauma registry? Is collected prospectively or reported retrospectively from prospectively collected data	<u>If yes continue to next question. If not exclude d/t ‘not registry study’</u> Note: include if retrospective use of prospectively collected registry data Exclude if the study is a simple prospective study but doesn’t refer to the words ‘registry, database, surveillance’ i.e. ad-hoc collection of trauma data or community-based survey of injury patients; exclude if retrospective chart review (of patient notes)
Q4. Was the whole data collection period collected after 2000? For the specific article in question (and not for the registry itself which will likely have been collecting data for some time before)	<u>If yes - include.</u> Include if ANY part of the collection falls after 2000. I.e. data collection period started before the year 2000 but ended after the year 2000. If not exclude d/t ‘outside of study dates’

Extraction guide

Filling in the remaining fields. What follows is guidance for extracting the remaining empty fields. Remember that we are interested in the non-reporting of variables as part of the aims of the review.

So, unless otherwise specified, even if the information can be deduced from your knowledge of institutions, authors or indirectly from information in the source, if it is not explicitly reported then you must write “not reported”.

Q5. Country of recruitment. Which African country was this study conducted in? <i>This is NOT the country of the lead author’s institution but must be explicitly mentioned directly in the text</i>	<u>If the collection concerns injury sustained anywhere outside of Africa ~ exclude</u> <u>e.g. study on injured African immigrants in a non-African country should be excluded.</u> <u>Write the country name.</u> if this has not been mentioned, write: “not reported”
Q6. Data collection dates (Mon-Year) <i>Usually found in the methods section this refers to the dates when the injuries were sustained even if they are retrospectively extracted from previously collected registry data</i>	<u>Provide the day, month and year of collection.</u> <u>The cell is formatted in such a way that month is displayed irrespective of the day recruitment was started off ended. I.e. Jan-2015 even if the collection started on 29 January 2015.</u>
Q7. Is a reporting guideline used in reporting this study? Y/N <i>i.e. STROBE, STROCCS etc</i> <i>this is usually found at the end of the methodology section</i>	<u>If reported, then write “yes”</u> <u>If not mentioned, please write: “no”</u>
Q8. if yes which reporting guideline is used?	<u>If you answered yes to the previous question, then give the full name of the reporting guideline e.g.: Strengthening the Reporting of Observational studies in Epidemiology</u>
Q9. Coverage The possible options in this field are: • Institutional	<u>If the registry collects only people with trauma from a hospital or group of hospitals, then it is institutional.</u> <u>If it collects all hospitals in a region then regional</u>

<ul style="list-style-type: none"> • Regional • National 	<u>If nationwide then national.</u>
Q10. Number of institutions	<p><u>Give the number of institutions included in the data from this paper as a number.</u></p> <p><u>Many of the sources will report data from one institution therefore: 1. While others will report from multiple institutions e.g. 4, 5 etc...</u></p>
Q11. Health system level Health system coverage means what level are the included health facilities. -primary, secondary, tertiary, quaternary (district, provincial, central) use any of those words as they are mentioned in the manuscript. Or 'not reported' if applicable or 'mixed' if applicable.	Use the words as they are used in the manuscript.
Q12. Rural/Urban Classification Rural, urban, semi-urban or not reported	<u>If in an urban area, then write urban if in a rural area then write rural.</u> Use the words as they are used in the manuscript.
Q13. Ownership of institution The options in this field are: <ul style="list-style-type: none"> • Public (i.e. government hospital) • Private • NGO (non-governmental organisation) • FBO [Faith based organisation.] (sometimes called mission hospitals) • Local authority (municipality) 	<u>Please provide one of the options to the left or free text if these options do not account for another type that comes up.</u> <i>This information is found in the sub-Saharan list of health care facilities (attached) for each facility</i>
Q14. Registry Name Please give the name of the registry if it has one referred to in the source. This is sometimes the name of the hospital or region or country.	<u>If reported, write the name e.g.: The Uyo Trauma Registry or the Childsafe South Africa (CSA) database.</u> <u>If not reported write "not reported"</u>
Q15. Type This refers to how the data is collected (and NOT whether they are stored in an electronic database like redcap. The options in this field are: <ul style="list-style-type: none"> • Paper-based • Electronic 	<u>Return one of the options (or another category not covered by the options)</u> <u>If not mentioned, then write: "not reported"</u>
Q16. Number of Pages This is intended as a (measure of the length of the registry and therefore difficulty in completion). Refers to the registry data collection tool used and not the article itself. The tool may be included as an image or a supplement to the paper.	<u>Give a number for the number of A4 pages (single side) of the registry.</u> <u>If not mentioned, then write (not reported)</u>
Q17. Number of items This refers to the number of datapoints collected in the registry and is also a measure of length of registry.	<u>If reported write the number of items</u> <u>If not mentioned, then write: "not reported"</u>
Q18. Scope Type of injuries covered in the registry. Has the following options" <ul style="list-style-type: none"> • Transport injuries (including pedestrian) • Unintentional injuries (falls, burns etc) • Intentional injuries (self-harm, violence, etc.) • All • Some combination (please specify) 	<u>Write the cause of injury covered or the relevant combination.</u> <u>If non-specific then then write "all". i.e. it is non-specific and collects information on all causes and mechanisms of injury.</u> <u>The field "not reported" is not an option in this field. This is a purely descriptive field</u>

<p>Q19. Cause specific? Is this registry specific to a narrow cause or mechanism of injury e.g. gun shots, burns, orthopaedic injuries, fractures etc.</p>	<p><u>If the cause is known write the cause specification of the source if not specific, then write “all”. i.e. it is non-specific and collects information on all causes and mechanisms of injury.</u></p>
<p>Q20. Anatomical region specific? Is this source limited to one anatomical region e.g. head injuries, extremity fractures or ocular injuries?</p>	<p><u>If the anatomical specificity is reported give the region</u> <u>If non-specific then write all.</u> <u>The field “not reported” is not an option in this field. This is a purely descriptive field</u></p>
<p>Q21. Phase of care Refers to whether the literature reported data only from the ED/casualty/A&E; or also included prehospital data (i.e. ambulance, paramedic etc), operative data (from operating theatre) etc.</p>	<p><u>If the variables collected refer to care in any one of these phases write yes in the relevant column.</u> <u>For each phase of care that is not collected write no.</u> <u>(many registries collect data from the A&E only while others collect data from the whole patient encounter)</u> <u>The field “not reported” is not an option in this field. This is a purely descriptive field</u></p>
<p>Q22. Who collects the data? Does the source explicitly say who is collecting the data/filling the forms of the registry? Can include: data clerks, nurses, medical doctors, administrative staff.</p>	<p><u>If mentioned: write the persons responsible from the options to the left or add an additional category is necessary.</u> <u>If not mentioned write “not reported”</u></p>
<p>Q23. Are they pre-trained? Does the source mention any training of data collectors or registry staff.</p>	<p><u>Use the words as they are used in the manuscript</u></p>
<p>Q24. Was the registry piloted before implementation? Was the registry tested in a shortened form or in a small sample before it was rolled out?</p>	<p><u>Use the words as they are used in the manuscript</u></p>
<p>Q25. Was the tool used derived from a pre-existing registry? Some sources might say something like: “we used a modification of the WHO tool” or “a modification of a previously published tool such as the cape town tool” etc. this means the tool is based on or built off a previous tool.</p>	<p><u>Use the words as they are used in the manuscript.</u> <u>Correct inputs might include the name of the registry or the reference of the tool cited i.e. DOI number or article title if no DOI exists.</u></p>
<p>Q26. Children included? Is data from children included in the source. Either explicitly reported or just included undeclared in the results</p>	<p><u>If children are included in the study answer “yes”</u></p> <p><u>If they are not included return “no”.</u></p> <p><u>If it is not clear if the data includes children return “not reported”. (i.e. they don’t report this in the methods and only report a mean or median age but no range or indication whether there were included)</u></p>
<p>Q27. How are children defined (years)? Many sources define children using different age ranges leading to inconsistency.</p>	<p><u>Return this field as a range if the answer to the previous question was yes. E.g. 0 – 18 or 0 to 13 years.</u></p> <p><u>Return this as N/A if no children were included or it is unclear.</u></p> <p><u>Return this as “not reported” if no definition is offered or if children are lumped in with adults with no sub analysis or age disaggregation.</u></p>
<p>Q28. Entry point (presented/admitted/operated)</p>	
<p>Q29. Exclusion Criteria Have clear exclusion criteria been reported? (Those not covered already in this template i.e. cause of injury or anatomical region or age.)</p>	<p><u>List these separated by a comma e.g.: abc, xyz, def, mno.</u> <u>Use the words as they are used in the manuscript. (copy/paste)</u> <u>If not mentioned write “not reported”</u></p>
<p>Q30. Data quality</p>	<p><u>Use the words as they are used in the manuscript.</u> <u>If not mentioned write “not reported”</u></p>

Is there any mention of how data quality was ensured? Includes any metrics used or checks done.	
Q31. Missing data Is there any mention of how missing data was assessed including any metrics used or checks done. E.g. checking the registry against an independent patient register or administrative list.	<u>Use the words as they are used in the manuscript.</u> <u>If not mentioned write “not reported”</u>
Q32. Variables collected. What variables did the source collect? Possible variables include clinical variables e.g.: <i>Data on demographic profile, mechanism of injury, baseline clinical state, radiological findings, management, and outcomes</i> <i>Or economic variables such as medical cost, out of pocket expenditure etc</i> <i>Or any other variable collected.</i>	<u>List the variables using the words as they are used in the manuscript one after the other. (copy/paste)</u> <u>List these variables separated by a comma e.g.: abc, xyz, def, mno.</u> <u>Usually, the source will report a least one variable collected and therefore the answer “not reported” is usually not an option in this field.</u>
Q33. Scores Were any injury severity scores used? there are many possibilities including AIS, Injury severity score, Kampala injury score etc.	<u>Use the words as they are used in the manuscript.</u> <u>If not mentioned write “not reported”</u>
Q34. Outcomes What outcomes were used in the source. these may include: Complications: <i>An adverse event that occurred during the patient's stay at the reporting facility</i> Facility disposition: dead/alive, discharged, transferred, admitted etc. Total Number of Ventilator Days Number of Operating Theatre Encounters Emergency Unit Disposition Functional status at disposition Wait time. Length of stay Quality of life Standardised Diagnosis: final <i>diagnosis using a standardised (or non-standardised) diagnostic classification system</i>	<u>List the outcomes mentioned in the manuscript using the words used. The outcomes are not limited to those listed to the left.</u> <u>Usually, the source will report a least one outcome collected and therefore the answer “not reported” is usually not an option in this field.</u> <u>In the unlikely event that no outcomes are evident then write “not reported” this field will be reviewed by an independent reviewer.</u> <u>List these separated by a comma eg: abc, xyz, def, mno.</u> <u>OUTCOMES ARE ALSO VARIABLES! SO LIKELY THESE WILL ALSO APPEAR IN Q32 WHICH IS FINE.</u> <u>Some sources list them in different parts of the manuscript, and it might be more convenient to list them here separately.</u>
Q35. Follow-up duration In days, weeks or years please specify	<u>Use the words as they are used in the manuscript.</u> <u>If not mentioned write “not reported”</u>
Q36. Follow-up method How was follow-up achieved? I.e. telephone call, WhatsApp, SMS, outpatients’ clinic, home visits, etc	<u>Use the words as they are used in the manuscript.</u> <u>If not mentioned write “not reported”</u>
Q37. Follow-up percentage Did the source compare how many patients were successfully followed up.	<u>Use the words as they are used in the manuscript.</u> <u>If not mentioned write “not reported”</u>

9.5 Appendix 5

Interview Guide trauma registry implementation

Study name: Barriers and Facilitators to Implementing a Trauma Registry in Zimbabwe

General Information

Date:

Interviewer Name:

Start Time:

Participant Name:

End Time:

Also in Attendance:

Introduction

Introduction to the study:

- Thank you for taking the time to participate in this interview.
- This study seeks to understand the barriers and facilitators to implementing a trauma registry in Zimbabwe and the things we would need to think of when trying to implement and scale one in the future.
- Your responses will remain confidential, and no personally identifiable information will be shared.
- Do you have any questions for us before we begin?

Consent Process

- Do you consent to take part in this study?
- Do you consent to an audio recording of this interview being made and stored?

Section 1: Background and Context

1. What is your current role and how does it relate to injury data collection or trauma care?
2. Can you describe your experience with data collection in the hospital or health system?
3. Are you aware of any past efforts to establish a trauma registry in Zimbabwe? If so, can you describe what happened?
4. What do you think are the most important gaps in injury data collection and use in Zimbabwe?

Section 2: Barriers and facilitators for implementation

Intervention Characteristics

1. What are your thoughts on the idea of a trauma registry? Do you think it is needed in Zimbabwe? Why or why not?
2. How should a trauma registry form be designed to fit within the current healthcare and hospital system?
3. What features should be incorporated to make a trauma registry useful and feasible in Zimbabwe?
4. What concerns do you have about the burden of data collection for clinicians and other staff?

Inner Setting (Institutional and Organizational Factors)

1. What challenges exist within hospitals that might pose a difficulty to implementing a trauma registry?
2. What aspects of hospital infrastructure (e.g., staff, technology, leadership support) either help or hinder implementation?
3. How do you think a trauma registry would affect current workflow and documentation practices?
4. How receptive do you think hospital leadership and staff would be to using a trauma registry?

Outer Setting (Policy, Regulation, and External Influences)

1. What role does government policy and regulations from the government, ministry and councils play in facilitating or obstructing trauma data collection?
2. How do external funding, NGOs, or international organizations influence hospital data collection practices?

3. What are the legal or ethical issues related to trauma data collection and sharing in Zimbabwe?
4. How important is data sovereignty, and what are the key concerns regarding data ownership and storage?

Individuals (People Involved in Implementation)

1. Who should be responsible for collecting the trauma registry data, and how should they be trained?
2. How motivated do you think healthcare workers would be to collect trauma data for this registry? What would incentivize them to do so?
3. What role do non-clinical staff (e.g., health informatics officers, data clerks, administrative staff) have in making a trauma registry successful?

Process (Implementation Strategies and Sustainability)

1. What steps should be taken to introduce and integrate a trauma registry into existing hospital processes and structures?
2. Which current processes present an opportunity/barrier to add trauma registry to them?
3. How should staff be engaged and trained to ensure adoption and use of the trauma registry?
4. What kind of monitoring and evaluation mechanisms should be used to maintain quality in the trauma registry?
5. What do you think are the biggest risks to sustaining a trauma registry in the long-term? How could these be mitigated?

Section 3: Usability Testing (for Participants Reviewing Forms)

(Show WHO standardised clinical form and Red Cross Children's Hospital form)

1. Looking at this form. How usable is this form? Would you or your colleagues use it?
2. Does it capture the necessary information for a trauma registry and its uses?
3. What makes this form good? What challenges can you see coming up when using it?
4. Are there any missing data fields that should be included?
5. What practical changes would make this form for daily use?

Final Thoughts

1. How do you see trauma data collection evolving in Zimbabwe over the next decade?
2. What advice would you give to anyone trying to implement a trauma registry in Zimbabwe?
3. Is there anything else you would like to add that we haven't covered?

9.6 Appendix 6

Research Topic Guide (IDI-1)

Participant: patients, parents/guardians of (*injury victims*)

Reminder to RAs:

The overall purpose of the qualitative component of the formative research is to understand:

- Participants perceptions about the causes of injuries in Zimbabwe
- Participants health seeking behaviours and choices when they are injured
- Participants perspectives of their journey from injury to care in the Zimbabwean health system
- Access to, acceptability and uptake of injury care services and barriers to access
- What injury interventions could and should be deployed in the community, and mode of delivery to do so
- The feasibility and acceptability of delivering a community-based injury prevention intervention

The ultimate goal of the data collection is to inform: the conduct of an upcoming cohort study and randomised control trial in injury prevention.

The questions included here are not exhaustive and they are not prescriptive. This means that as the interview progresses, you may ask questions that are not included below, and similarly, it may not be appropriate or necessary to ask all of the questions included in this topic guide- *the discussion should be guided by what your participant says, NOT by the topic guide.* For that to happen, make sure that you're familiar with the guide so that so that you can engage more fully in the discussion, and be responsive to what the participant is telling you, by exploring these responses further. Try to integrate some of the information that they have told you into your subsequent questions – this will demonstrate that you're listening, and give participants a chance to clarify anything you might be misunderstanding. It is important for you to show that you are interested in what they are saying, and that you are there to learn from them.

Modify the subject of the questions as appropriate. Either an adult participant or a parent/guardian of an injured child

Introduction to Participants

(note: this is an example so that you can see how we'd like the interview and the process to be explained, but you will likely want to adapt this to your own style)

“Thank you for taking the time to speak with me today.”

“My name is _____ and I am working with a research project to learn more about injury in Zimbabwe and services for injured people in Zimbabwe. **We are very interested in learning about patients’ experiences - including yours- but it’s up to you whether or not you want to talk about your own experiences or draw on experiences you might know of about other people in your community, or your friends.**”

“When I say injuries, I mean anything that can hurt someone including fire, heat, and hot substances, transport injuries, poisonings, foreign body, drowning, animal contact, falls etc”

“The interview will take about 60 minutes. I appreciate you spending this time with me.”

“I am going to audio record the interview to make sure that I capture all the valuable information that you share with me. I may also write things down while we’re talking so that I don’t forget anything. Participation is voluntary- you do not have to answer any question that you don’t want to, and you can choose to stop the interview at any time.”

“Everything you say is confidential, so please feel free to talk about your experiences and ideas. We will not record your name anywhere, and no one else will hear the tape or see the notes besides the people who are working on this research project. We will never use your name. “

“If you have any questions about this study, you can ask me now, or at any time during our conversation **(RA: make sure you have collected signed consent form and answered any questions.)**”

Start the **tape recorder**.

General Topics	Rationale	Suggested Questions	Notes
<p>Getting to know them and the context of their lives and family</p>	<p>Initially we want the respondent to feel comfortable talking to us- these questions are meant to ease them into the discussion. This will also help us get a sense of their world and what their priorities are.</p>	<ol style="list-style-type: none"> 1. Tell me about yourself: <ol style="list-style-type: none"> a. Where do you live? b. What is your age? c. What is your occupation? d. What level of education have you attained? e. What do you do for fun? f. How many children do you have? g. Where is the other parent/guardian? h. Who do you live with? 	<p>This is useful to get people talking- this will be the first time you're meeting participants. This also establishes baseline information to understand the parent, their living circumstances and the family situation.</p>
<p>Circumstances of the child's most recent injury In the patient journey</p>	<p>Here we are interested in getting some information about the current admission and the injury that led to it. We also want to know about the referral journey to care. How many referrals till they arrived here, how easy or difficult was it</p>	<ol style="list-style-type: none"> 1. What happened to your child? When were they injured and how did it happen? 2. Where exactly did the incident happen? Look at a map is appropriate. 3. What first aid did you give when the injury happened? 4. If answered in the affirmative, ask where did you hear about this first aid? 5. Where did you go first for attention? How long did it take? How did you get there? why did you chose this place? 6. Where did you go second/referred and why? 7. Where did you go third/referred and why? 8. Did you experience any challenges on your journey to get help? 9. How do you feel about the care you received? 10. Where there any challenges you experienced in the hospital emergency department and on the ward? 11. How easy will it be to come back for review of your injuries? 	<p>Ask people to describe the patient journey and any challenges they experienced along the way</p>
<p>Feelings and perceptions of the current injury/risk</p>	<p>Here we are trying to get information about emotions and state of mind of the parent after the injury, feelings of personal blame or blame for others, perceptions of risk, ideas about the inevitability of injury or the ability to avoid them.</p>	<ol style="list-style-type: none"> 1. How did you feel when your child was injured? E.g. depressed, afraid, calm, helpless? 1. Do you need any support for your feelings about the injury? 2. What do you think was the cause of the injury 3. What do you think is the risk of this kind of injury? 4. Do you think this injury could have been avoided? 5. Ask about what does culture say about supervising children at home or accompanying them to school? Should children be allowed to play wherever they want? Is that how you were raised? 	

Health care seeking behaviour	<p>Here we are interested in understanding what different options for injury care are and which ones the parent ordinarily uses for different situations.</p> <p>What is the threshold for them to seek care for an injury? So we can understand utilisation of the health system or alternatives.</p>	<ol style="list-style-type: none"> 1. What are the different options for care when your child has been injured? <i>E.g. Nothing, home-based care (gogo or other), Council clinic, govt hospital/clinic, private doctors' rooms, private hospital, traditional healer, other?</i> 2. Which of these options have you used and in which situations? Where do you go first? What do you do for minor injuries and where do you go for those compared to serious injuries? 3. What do you think of hospital services? What do other people say about them? 4. If you did nothing for a past injury how serious was it and what influenced your decision not to seek care? 5. What might be the reasons that people don't go to get medical attention? (How about you?) Do you have any ideas on what could be done to change that? 6. What would a really good injury care service for young people look like? <ol style="list-style-type: none"> a. What needs to be done differently for young people compared to adults? 	<p>Ask specifically what do you expect from city council clinics?</p>
Perceptions in general about injury	<p>Here we are interested in their perceptions of injuries in general, health system barriers and prevention interventions</p>	<ol style="list-style-type: none"> 1. What do you think are the main issues related to injury affecting children and young people in your community/Zimbabwe? <ol style="list-style-type: none"> a. What do you think are stopping these from being dealt with? Or what are making these problems worse? 2. What do you think should be done to prevent injuries in children in Zimbabwe? for burns, for road traffic accidents drowning and other causes? 3. What type of challenges or barriers do children and young people face in terms of accessing care for injuries? <ol style="list-style-type: none"> a. Are these challenges or barriers different with different ages or with male adolescents and young people? Why is that do you think? 4. What could be done to make it easier for those young people who have been injured? 	

In this next section we will introduce the participant to an upcoming study on injury in children in Zimbabwe including burns, road accidents and others:

“in the future we are going to start a research project to find out the causes of injury in children and to understand the reasons why they get injured around the country. This research will take place in major hospitals next year. The procedure for the research is exactly the same as for normal care at any hospital, no blood will be taken or procedure done beyond what is required for the child’s injury.”

These questions relate to a study in the future and not to the current research.

Do you have any questions about the research?

	<p>Here we want to understand acceptability of the upcoming research project activities for patients. These include taking consent at the same time as the patient encounter process, follow-up, and Facilitators and barriers to taking part.</p>	<p>How do you feel about this research into injuries? Do you think it is a good thing? Do you think it is useful? How do you think we should research injuries? Who should we ask and where should we research?</p> <ol style="list-style-type: none"> 1. In this study the doctor seeing patients will ask the parents immediately after they are first seen and will ask them to take part in the research. what do you think of this? Is there a bad time to be approached about research like this? Who would you feel comfortable approaching you about research like this – doctor, nurse, research nurse not involved in care, someone else? 	
--	--	--	--

		<ol style="list-style-type: none"> 2. During this research the doctor will also ask questions about the costs incurred during this injury and your home financial position. Would you be ok with this? Are there any questions you wouldn't have wanted to be asked about? 3. As part of this study the research doctor will contact you up to 30 days after your discharge from hospital to check on the child and their progress in recovering. How do you feel about this? Would you still feel motivated to answer general questions about your child's health? Which option for contact is best for you? Phone call? WhatsApp message? Text message? Email? Other? 4. What do you think would encourage people to take part in this type of research? Can you think of anything that would have encouraged you to take part? 5. What do you think would stop people from taking part in this type of research? Can you think of anything that would have stopped you from taking part in this type of research? 6. What else do you think should be included in this research? 	
Asking about patient support group and patient advocacy groups	Here we want to ask about their thoughts about forming a patient group for victims of injury to have their voice heard.	<ol style="list-style-type: none"> a. Are you a member of any support groups for parents of injury victims? If YES, which one? Can you tell me about what you do there? How do you feel about it? If NO, why not? Would you like to be part of one? 	
Wrapping up	<p>This is to ensure that we haven't missed anything, but also to help people revisit points that they would expand on now since they have been thinking about it throughout the interview process.</p> <p>It also leaves people feeling that they have made a valuable contribution.</p> <p><i>We should make sure that we are expressing gratitude to them and appreciate learning about their ideas and experiences.</i></p>	<ol style="list-style-type: none"> 1. Given our focus, as we chatted about at the beginning, we'd really like to hear any other thoughts that you have that haven't been covered in this interview or that you'd like to give more emphasis to. Is there anything that we need to know do you think to help us design this intervention? 2. If you were trying to prevent injuries, what would you do, and what do you think a prevention program should definitely contain? 	

AREA OF BODY INJURED

<input type="checkbox"/> Scalp	<input type="checkbox"/> Brain (open)	<input type="checkbox"/> Shoulder	<input type="checkbox"/> Elbow	<input type="checkbox"/> Abdominal wall	<input type="checkbox"/> Chest viscus	<input type="checkbox"/> Lumbar spine	<input type="checkbox"/> Lower leg
<input type="checkbox"/> Skull	<input type="checkbox"/> Face	<input type="checkbox"/> Upper arm	<input type="checkbox"/> Wrist	<input type="checkbox"/> Abdominal viscus	<input type="checkbox"/> Cervical spine	<input type="checkbox"/> Pelvis	<input type="checkbox"/> Knee
<input type="checkbox"/> Brain (closed)	<input type="checkbox"/> Neck	<input type="checkbox"/> Arm	<input type="checkbox"/> Hand	<input type="checkbox"/> Chest wall	<input type="checkbox"/> Thoracic spine	<input type="checkbox"/> Upper leg	<input type="checkbox"/> Foot

EMERGENCY UNIT DETAILS

EMERGENCY UNIT INTERVENTIONS

<input type="checkbox"/> Splint	<input type="checkbox"/> Traction	<input type="checkbox"/> Dressing	<input type="checkbox"/> Amputation	<input type="checkbox"/> Airway adjunct	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Antibiotics
<input type="checkbox"/> Casting	<input type="checkbox"/> Chest tube	<input type="checkbox"/> Suturing	<input type="checkbox"/> Tracheostomy	<input type="checkbox"/> Other: _____		

CAS DEPARTURE DATE CAS DEPARTURE TIME (24-hr) DISPOSITION: _____

SOCIOECONOMIC INFORMATION

PATIENT/GUARDIAN OCCUPATION

MEDICALLY INSURED?

HOUSEHOLD ARRANGEMENTS

HOW MANY ROOMS DO YOU USE?

WHERE IS THE COOKING DONE?

IN A SEPARATE KITCHEN
 IN A SEPARATE BUILDING
 IN THE BEDROOM/LIVING AREA
 OUTDOORS

WATER TEMPERATURE

PIPED HOT WATER
 PIPED COLD WATER
 NO PIPED WATER

WHAT IS THE HIGHEST LEVEL OF SCHOOL EACH PARENT/GUARDIAN HAS ATTENDED

#1	#2	
<input type="checkbox"/>	<input type="checkbox"/>	PRE-PRIMARY
<input type="checkbox"/>	<input type="checkbox"/>	PRIMARY
<input type="checkbox"/>	<input type="checkbox"/>	SECONDARY
<input type="checkbox"/>	<input type="checkbox"/>	HIGHER
<input type="checkbox"/>	<input type="checkbox"/>	DON'T KNOW
<input type="checkbox"/>	<input type="checkbox"/>	N/A (INELIGIBLE)

MAIN SOURCE OF WATER FOR COOKING/BATHING?

PIPED INTO HOUSE
 PUBLIC TO NEIGHBOR
 PUBLIC TAP/STANDPIPE
 BOREHOLE
 PROTECTED WELL
 UNPROTECTED WELL
 CART WITH SMALL TANK
 BULK WATER TANKER TRUCK

WHAT TYPE OF FUEL DOES YOUR HOUSEHOLD MAINLY USE FOR COOKING?

ELECTRICITY
 LIQUID PROPANE GAS (LPG)
 BIOGAS
 KEROSENE
 WOOD
 OTHER (SPECIFY)

HOW DOES YOUR CHILD GET TO SCHOOL?

WALKING ALONE
 WALKING ACCOMPANIED
 BICYCLE
 BUS
 HITCHHIKING

FINAL OUTCOMES

ALIVE? LENGTH OF HOSPITAL STAY? FINAL DIAGNOSIS:

DEAD? BROUGHT IN DEAD IN CASUALTY PERIOPERATIVE DEATH IN WARD AFTER DISCHARGE

9.8 Appendix 8

OXTREC research ethics approval

Oxford Tropical Research Ethics Committee

University of Oxford
Research Services, Research Governance, Ethics & Assurance
Boundary Brook House, Churchill Drive, Oxford OX3 7GB
Tel. +44 (0)1865 (2)82106
E-mail: oxtrecreg@admin.ox.ac.uk



Prof Kokila Lakhoo
Nuffield Department of Surgical Sciences
133 Woodstock Road, OX2 6HW
United Kingdom

17 August 2022

Dear Prof Kokila Lakhoo

Full Title of Study: Development of a hospital based injury surveillance tool for paediatric unintentional injury in Zimbabwe, a mixed methods study.

OxTREC Reference: 543-22

Thank you for your email of 16/08/22 and for your updated minimal risk application form.

I am pleased to confirm that approval has now been granted for this study. This is valid for the planned duration of the study as detailed in the application **and is subject to receiving local ethical approval** (if this approval has not yet been received).

The documents approved for this study are as follows:

Documents:	Version:	Date:
Oxtrec-minimalrisk-application-form	1.2	16/08/2022
Consent Form for interviews	1.2	16/08/2022
Assent Form	1.3	17/08/2022
Oxtrec-consent-form-healthcare-workers	1.2	16/08/2022
Oxtrec-participant-information-sheet	1.2	06/2022
PIS health care workers	1.2	16/08/2022
Poster for recruitment	1.2	16/08/2022
Semi-structured interview guide	1.1	06/2022

Any subsequent changes to the application must be submitted to the Committee as an Amendment. This should include a letter to give the reasons for the proposed modifications and all revised documents with changes tracked.

Please ensure that you submit a completed Annual Report form on every anniversary of this approval and a final End of Study Report. The relevant forms can be found on the [OxTREC website](https://researchsupport.admin.ox.ac.uk/governance/ethics).

Finally, please note the following **important information**:

Data safety—all studies

It is the responsibility of the PI to ensure that all data collected during the course of the study is

Tel: +44 (0)1865 (2)82106
Email: oxtrecreg@admin.ox.ac.uk Web: <https://researchsupport.admin.ox.ac.uk/governance/ethics>

stored and transferred safely and securely. Further guidance and advice are available from the [Research Data Team](#).

Only studies that will involve storing human tissue samples in Oxford

If you are planning to import the samples into England, you will need to make arrangements before the samples are transferred to store them under the governance of a Human Tissue Authority (HTA) licence. It is a legal requirement that any tissue or fluid made up of or containing human cells to be used for the purpose of research is stored on premises licensed by the HTA unless covered by an exemption. OxTREC approval is not a recognised exemption. Further information may be found on the University's [human tissue governance web pages](#).

Yours sincerely

DocuSigned by:

6B38ECA41CDB44E...

Dr Rosemary Musesengwa
Research Ethics Manager, OxTREC


9.9 Appendix 9

Zimbabwe hospital ethics approval 1

Telephone: 021 290 10
Fax: 421117

Reference: SMCHEC 280422/57

SALLY CENTRAL MUGABE HOSPITAL
P.O. BOX 8714
SOUTHERTON
HARARE
ZIMBABWE



ZIMBABWE

27 May 2022

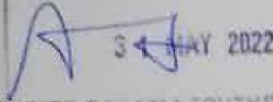
Dr Dennis Mazingi
5 Viewdale close
Borrowdale
Harare

REF: DEVELOPMENT OF A HOSPITAL - BASED INJURY SURVEILLANCE TOOL FOR UNINTENTIONAL INJURY IN ZIMBABWE, A MIXED METHODS STUDY

I am glad to advise you that your application to conduct a study entitled **DEVELOPMENT OF A HOSPITAL - BASED INJURY SURVEILLANCE TOOL FOR UNINTENTIONAL INJURY IN ZIMBABWE** (Ref: SMCHEC280422/57), has been approved by the Sally Mugabe Central Hospital Ethics Committee.

This approval is premised on the submitted protocol. Should you decide to vary your protocol in any material way please submit these for further approval.

You are advised to avail the results of your study whether positive or negative to the hospital through the committee for our information.

HARARE CENTRAL HOSPITAL
DEPARTMENT OF MEDICINE
Yours Sincerely,

3 MAY 2022
DR. C. PASI
SOUTHERTON
HARARE ZIMBABWE
Chairman Sally Mugabe Central Ethics Committee

Board Members, Chairman Dr E Chagonda, Deputy Chairperson Ms A Mashamba, Members:- Mr J Makiya, Mrs P Sibanda, Mr S. Hlatywayo, Dr C. Pasi (Acting Chief Executive Officer)

9.10 Appendix 10

Zimbabwe hospital ethics approval 2

Telephone (263) (292) 2252111-9
Website: www.ubh.org.zw
E-mail: info@ubh.org.zw
All Correspondence to be addressed to the:
**CHIEF EXECUTIVE OFFICER
UNITED BULAWAYO HOSPITAL
P.O. BOX 958
BULAWAYO
ZIMBABWE**



**MINISTRY OF HEALTH AND
CHILD CARE
UNITED BULAWAYO HOSPITALS
CHIEF MEDICAL OFFICER
ST LUKES AVENUE
ASCOT
BULAWAYO
ZIMBABWE**

08 June 2023

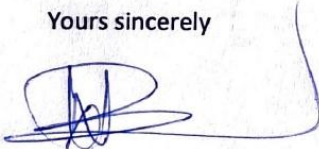
Attention: Dr Dennis Mazingi

RE: REQUEST FOR PERMISSION TO CONDUCT RESEARCH ON DEVELOPMENT OF A HOSPITAL-BASED INJURY SURVEILLANCE TOOL FOR PAEDIATRIC UNINTENTIONAL INJURY IN ZIMBABWE, A MIXED METHODS STUDY.

Reference is made to your minute on the above matter. Your request to carry out the above-named research has been approved. The institution has no objection to you undertaking the study which concerns an important national health problem: injuries.

Please avail the results of your study to the hospital through the office or publications for our information.

Yours sincerely



**W BUSUMANI
CHIEF MEDICAL OFFICER**



9.11 Appendix 11

Zimbabwe University ethics approval



UNIVERSITY OF ZIMBABWE
Faculty of Medicine
& Health Sciences

Joint Research Ethics Committee For The University of Zimbabwe, Faculty of Medicine and Health Sciences(FMHS) & Parirenyatwa Group of Hospitals(PGH)

JREC Office No.4, 5th Floor, Faculty of Medicine and Health Sciences Building
Telephone: +263 242 708140/791631 Extns 2241/2242
Email: jrec.office@gmail.com - website: www.jrec.uz.ac.zw



Parirenyatwa
Group of Hospitals

APPROVAL LETTER

Date: 23 May 2022

JREC Ref: 221/2022

Names of Researcher **Dennis Mazingi**

Address: UZ – **Department of Surgical Sciences**

RE: DEVELOPMENT OF A HOSPITAL-BASED INJURY
SURVEILLANCE TOOL FOR UNINTENTIONAL INJURY IN
ZIMBABWE, A MIXED METHODS STUDY.

Thank you for your application for ethical review of the above mentioned research to the Joint Research Ethics Committee. Please be advised that the Joint Research Ethics Committee has reviewed and approved your application to conduct the above named study. You are still required to obtain MRCZ and RCZ approval before you commence the study if required by the nature of your study.

- APPROVAL NUMBER: JREC/221/2022
- APPROVAL DATE: 23 May 2022
- EXPIRY DATE: 12 May 2023

This approval is based on the review and approval of the following documents that were submitted to the Joint Ethics Committee:

- a) Completed Application Form
- b) Full Study Protocol
- c) Informed Consent in English and/or appropriate local language

After this date the study may only continue upon renewal. For purposes of renewal please submit a completed renewal form (obtainable from the JREC office) and the following documents before the expiry date:

- a. Progress Report
- b. A Summary of Adverse Events
- c. A DSMB Report

- **MODIFICATIONS:**

Prior approval is required before implementing any changes in the protocol including changes in the informed consent.

- **TERMINATION OF STUDY:**

On termination of the study you are required to submit a completed request for termination form and a summary of the research findings/ results.

Yours sincerely,



Professor J. Chifamba
Deputy JREC Chairman
JC/uh