AN ERGONOMICS APPROACH TO UNDERSTANDING PERCEIVED BARRIERS TO THE PROVISION OF HIGH-QUALITY HEALTHCARE: A SARAH BAARTMAN DISTRICT CLINICS CASE STUDY

BY

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THESIS

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Abstract

Background: The complex nature of healthcare systems often results in the emergence of context-specific barriers that limit the ability for healthcare stakeholders to ensure safe and effective care delivery. In low- to middle-income (LMIC) countries, such as South Africa (SA), limited financial, material and human resources coupled with poor infrastructure and poor public health determinants, including poverty and poor education, affect the ability to maintain and improve on quality care outcomes. Understanding what different stakeholders perceive as barriers, and if these barriers are understood at different levels, is therefore important when attempting to mitigate the risk for unsafe or inefficient care delivery. Human Factors and Ergonomics (HFE) adopts systems and participatory approaches for the exploration, analysis, and design of socio-technical systems to optimize both human wellbeing and system performance. The barriers to safe and effective healthcare delivery, from an HFE perspective, are not known in the South African context, particularly in parts of the Eastern Cape Province. Elucidating these barriers, even if self-reported, may guide future efforts aimed at mitigating risks. The purpose of this study, therefore, was to explore and highlight the perceived systemic barriers to local and national healthcare delivery, within the Sarah Baartman District in the Eastern Cape Province of South Africa.

Methods: A short discussion aimed at introducing HFE and components of the Work Systems Model, followed by a survey that captured participant demographics, job characteristics, the perceived national and local systemic barriers, and proposed solutions, was administered with healthcare stakeholders from 14 primary healthcare facilities and 1 department office within the Sarah Baartman District. Participants (n=120) included management, pharmacy, administration, maintenance, community- and home-based care and nursing staff. Data from the surveys were thematically analysed and categorised according to components of the work system model (Carayon, 2009) and respective workgroup.

Results: The findings revealed many overlapping, systemic barriers that included shortages of staff, poor management and leadership, a lack of equipment and basic necessities, poor infrastructure, patient complexity, and high workloads. The results further indicate that the way in which the reported barriers affect work system interactions and performance are unique to different workgroups. Stakeholders

proposed that, among others, the absorption of contract workers, the provision of training and adequate human and medical resources and the maintenance of facilities may mitigate the barriers and improve healthcare delivery.

Conclusion: The findings highlight a myriad of perceived systemic barriers perceived in the Sarah Baartman district, some of which were fundamental for the effective function of any healthcare system. These barriers may have wide-spread implications for stakeholders at all levels, ultimately affecting the performance, satisfaction and safety and the quality of care. It is especially important to consider these barriers in light of the COVID-19 epidemic, which emerged throughout this study and the major threat it presents to South African healthcare systems. Future research should aim to explore how these barriers interact to contribute to processes and outcomes, as well as explore the perceptions at provincial and national levels in order to better identify areas and strategies for improvement.

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Chapter 1

Introduction

1.1. Background to the study

Healthcare systems, as defined by the World Health Organisation (WHO), refer to a collection of organisations, people and processes, whose primary goal is to promote, restore or maintain public health through the provision of high-quality care (WHO, 2010). As this thesis will highlight, care delivery is complex and depends largely on the needs of patients, as well as the capacity of organisations and providers to provide care (Carayon et al., 2006). This stems from the fact that care may be provided across a wide range of settings or facilities either formally in a healthcare facility or informally at home, and over time in the case of prolonged, chronic or acute care (Plsek and Greenhalgh, 2001; Carayon et al., 2006; Carayon, 2009; Carayon et al., 2020). Additionally, care may involve a wide range of individuals or teams of professionals and non-professionals, either clinical or non-clinical such as patients, families or staff, each with many different lines of administration, capacities, information gathering and decision-making abilities. With continuous changes in patient treatment needs, as well as rapid changes in technology, procedures, and work environments, it is increasingly challenging for health organisations to ensure that procedures and outcomes are desirable for both staff and patients (Carayon et al., 2006; Ben-Tovim et al., 2008; WHO, 2008; Carayon and Xie, 2014).

The many dynamic and non-linear interactions that occur among the various social and technical elements characterises health systems as complex, unpredictable and at times, fragmented (Carayon and Xie, 2014; National Academy of Science Engineering and Medicine, 2018). These characteristics result in many emergent barriers that create difficulties for healthcare stakeholders to make substantial investments and appropriate decisions to ensure safe work procedures and working environments. These barriers may be systemic in nature and in many cases reflect examples of poorly designed work systems which unfortunately contribute to unsafe or inefficient interactions between people and their work, ultimately limiting optimal system performance and desirable outcomes (Carayon et al., 2006; Holden et al., 2013; Carayon et al., 2014).

Literature suggests that adverse events, caused by poor quality care delivery, are a global threat (Institute of Medicine (IOM), 1999, 2001; National Academy of Science Engineering and Medicine, 2018) where patients in many contexts suffer the consequences of poor quality care. This can include, inter alia, delays in care delivery, further harm, or in many cases mortality (IOM, 2001; WHO, 2008, 2017; Makary and Daniel, 2016). In high-income countries (HICs), such as the United States (US) and parts of Europe, the rate of adverse incidents related to poor quality care occurs in at least 8% of hospitalizations (IOM, 2001; de Vries, Ramrattan, Smorenburg, Gouma and Boeremeeste, 2008; WHO, 2017). These adverse events, due to medical errors, are the third leading cause of death in the United States, behind heart disease and cancer (Makary and Daniel, 2016).

In the context of low- to middle- income countries (LMICs), these figures are not as well understood and may be exacerbated (Wilson et al., 2012). Reports by the National Academy of Sciences, Engineering, and Medicine (NASEM) suggest that 13.4 million adverse events occur in LMICs, which result in 8.6 million deaths annually from poor quality care (NASEM, 2018). This stems from health systems in these contexts facing various challenges associated with socio-economic and political pressure, as well as a lack of, or poor provision of adequate infrastructure and resources. This includes, inter alia, staff and equipment shortages, poorly designed working environments, poor service delivery, poor or absent management and leadership, all of which limit the ability to ensure safe and effective care delivery (WHO, 2008; Coovadia et al., 2009; WHO, 2010; Wilson et al., 2012; Jha et al., 2013; Managa, 2014; NASEM, 2018; Vaugh, Saint, Krein et al., 2019).

South Africa (SA), is one such LMIC that faces numerous, complex and varied challenges due to health burdens, scarce resources, poor or unreliable infrastructure and limited knowledge dissemination (National Department of Health, 2007; Managa, 2014; Mayeng and Wolvaardt, 2015). Although data on the prevalence of adverse events in South Africa is limited (National Guideline for Patient Safety Incident Reporting and Learning in South Africa, 2017), reports from the National Parliament, grey literature and personal communications with the Department of Health, have pointed to increasing numbers of costly and devastating events that result from poor quality care delivery (Maputi, 2017). For example, according to the Eastern Cape

Provincial Premier of the Executive Council (MEC), Sakhumzi Somyo, in 2017 nearly R6bn (~$344 million USD) in medico legal claims were lodged against the Eastern Cape Department of Health as a direct result of poor quality or negligent care provision (Maputi, 2017). Furthermore, communications with district management from within the Sarah Baartman District of the Eastern Cape, where this study is contextualised, reveal similar financial pressures from medico legal claims caused by poor quality care delivery. Beginning to understand what is contributing to these issues, from a systemic perspective, is critical in order to find ways of improving health care systems and the provision of care.

A systemic understanding of the context-specific barriers that emerge among people and the different elements of their work and which contribute to poor interactions may facilitate improvements to care provision (Carayon et al., 2006; Holden et al., 2013; Wooldridge et al., 2020). For example, in SA, the design of certain facilities has been found to limit the performance of staff by contributing to increased waiting times, overcrowding, and the inability to maintain facilities (Heunis et al., 2016; Klopper et el., 2016). These issues collectively and individually contribute to the increased risk for inefficiency, fallibility, and adverse events (Reason, 2000; Gurses and Carayon, 2009; Holden et al., 2013; Barker et al., 2017). By exploring the factors that contribute to poor systemic interactions and understanding the context in which they occur, insights around how to mitigate the risks to care processes and outcomes may be elucidated. Therefore, in order to facilitate improvement in care provision, appropriate systems analysis that holistically considers understanding the complex context-specific interactions among people and the different elements of their work is advocated (Karsh and Alper, 2005; Carayon et al., 2006, 2009; Holden et al., 2013; Karsh et al., 2014; Carayon et al., 2018).

Human Factors and Ergonomics (HFE) is a systems discipline that attempts to inform the design of work systems so to ensure that humans interact optimally within systems, such as healthcare, and that the processes involved are safe and effective for both the people as well as the organisation (Carayon et al., 2006; Dul et al., 2012; Wilson, 2014). While HFE adopts many different models and tools in the attempt to understand the interactions within a system, the Work Systems Model (Smith and Carayon, 1989; Carayon, 2009), which forms part of a more recent model - the Systems Initiative for

Patient Safety (SEIPS) model (Carayon et al., 2006; Carayon et al., 2014) serves as a useful framework to assist the description of the many complex interactions that occur between people and their work systems. Underpinned by socio-technical systems theory, the Work Systems Model is used to facilitate system exploration and analysis by providing a framework for categorising the context-specific characteristics that affect the different interactions among system components (Smith and Carayon, 2000; Carayon, 2009). In doing so, and with the help of those who design and form part of the system, unfavourable interactions can be identified and appropriate interventions can be developed in the attempt to achieve the dual achievement of human well-being and system performance (Smith and Carayon, 2000; Carayon, 2009; Hettinger et al., 2015; Wilson, 2014).

Participation of various stakeholders is critical to HFE's approach to system analysis and design (Haines et al., 2002; Hignett et al., 2005; Wilson, 2014). Understanding the different perspectives of stakeholders who work from within different parts of the system is crucial to facilitating effective identification of factors that may contribute to poor system interactions, which may present certain risks to those in the system (Haines et al., 2002; Van Eerd et al., 2016; Wilson, 2014). Rasmussen (1997), in his Hierarchical Risk Management framework model, highlights the importance of establishing a coherent line of communication across the different perspectives, or levels of work when attempting to manage risks in complex systems. Due to the complex, pressurised and dynamic nature of healthcare work systems, stakeholders at the sharp-end, where care meets the patient, often experience and deal with challenges and barriers that limit optimal performance, ultimately increasing the risk for poor quality care. According to Rasmussen (1997), in order to effectively manage risks these barriers and how they are dealt with needs to be understood from stakeholders in levels higher up, often referred to as the blunt-end, where decisions are made regarding policy development, resource procurement, and improvement efforts (Rasmussen, 1997; Reason, 2000).

Poor lines of communication or a lack of dissemination of information related to barriers and risks among these levels may result in disconnect or a lack of vertical integration where top levels are unaware and therefore unable to address the problems at the sharp-end. These unaddressed systemic challenges therefore continue to place strain

on healthcare systems, which in the context of resource strained systems, typical of public health facilities in the Eastern Cape, presents risks to both staff and patients.

Numerous authors have also indicated that context is vital in informing interactions within a system (Evenson et al., 2008; Wilson, 2014; Edwards and Barker, 2014; Carayon et al., 2015). Consequently, research published elsewhere may not be relevant to a specific local context (Edwards and Barker, 2014). Thus, understanding these challenges, from the perspectives of those who operate within them, affords the opportunity for appropriate, context-specific interventions to be developed and implemented. An HFE approach which considers the context-specific configurations of work systems and perspectives of stakeholders is therefore valuable in enabling appropriate system analysis and redesign efforts aimed at improving the quality of care (Carayon and Xie, 2014; Hignett et al., 2018; NASEM, 2018).

1.2. Problem statement

Due to the complex, uncertain and dynamic nature of healthcare, context-specific barriers emerge which make the achievement of high-quality care increasingly challenging. In LMICs such as South Africa, the occurrence of poor-quality care may be exacerbated as challenges related to political, economic and social aspects contribute to poor system interactions. HFE offers value through its user-centered and systems approaches to understanding systemic interactions and facilitate the dual optimisation of both human well-being and performance. To date, there has been no data published on an HFE perspective of health care in the context of the Sarah Baartman District in the Eastern Cape, South Africa. Exploring and understanding the various perceptions around barriers to safe and effective care delivery from within the Sarah Baartman District may be the first step needed to systematically understand, learn from and address context-specific barriers.

In light of this, the overall aim of this study was to explore, with HFE theory and approaches, the perceived systemic barriers to safe and effective high-quality care in South Africa and specifically, in the Sarah Baartman District in the Eastern Cape from local stakeholders at both the sharp and blunt-end of the care process.

The objectives of this study were to use the Work Systems Model as a framework to highlight the barriers that contribute to poor systemic interactions, at both a national

and local level, as perceived by local stakeholders, while also gaining insights into possible solutions or interventions proposed by these stakeholders.

1.3. A brief overview of the thesis

In Chapter 2 appropriate literature is reviewed to characterise health systems and elaborate on the importance of achieving their goals (ensuring high-quality care and patient safety). The review of literature will provide relevant emerging evidence of poor-quality care, and how issues of complexity contribute to poor care delivery in all global contexts. This chapter will describe how the application and consideration of various principles and approaches that underpin Human Factors and Ergonomics aim to optimise the interactions within complex socio-technical systems so to ensure safe and effective outcomes, particularly in the context of South African district public healthcare facilities. Chapter 2 will also describe the South African context, specifically the inherent challenges to healthcare provision. Chapter 3 of the thesis will then present and describe the methodology adopted to explore and understand the perceived barriers to healthcare delivery in the Sarah Baartman district context. This chapter will describe the study setting, preparations, protocols and analysis methods set forth by the researcher. Chapter 4 will report on the results, while Chapter 5 aims to discuss the key findings, in light of the reviewed literature in Chapter 2. Furthermore, this chapter aims to discuss the relevant findings in light of Human Factors and Ergonomics, as well as the related implications and recommendations for the context in focus. The findings are also discussed in the context of the COVID-19 pandemic. Lastly, Chapter 6 concludes the thesis by highlighting key findings and recommendations drawn from this research.

Chapter 2

Review of literature

2.1. Defining healthcare systems and their goals

Dul et al. (2012) define a *system* as a "set of interdependent components, each with their own function, interacting with other components to form a larger, more complex interconnecting network, to achieve a larger, common purpose or goal" (Dul et al., 2012, p. 379). Additionally systems are described by Edwards and Jensen (2014) as "a transformation process" which results from system components jointly interacting, in a goal-orientated manner to transform a combination of inputs into material or immaterial outputs such as products or services (Edwards and Jensen, 2014, p. 27).

Healthcare systems specifically are defined as a collection of organisations, people, and processes that interact to transform inputs (such as resources, knowledge and information) in a goal-orientated manner, into outputs (Karwowski, 2006). These goals and outputs are health services that aim to ensure the promotion, restoration and maintenance of public health (World Health Organisation (WHO), 2010). An essential requirement for health systems to achieve their goals is, therefore, to ensure that the care provided is of high quality (Corrigan, 2005).

2.1.1. Defining high-quality care

Quality of care is defined by the Institute of Medicine (IOM) as "the degree to which health care services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge" (IOM, 2001, p. 44). The concept of 'quality care' was further described under a framework comprised of six dimensions (IOM, 2001, p. 5-6) namely *safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity.* While this IOM report (2001) provides insight into what *quality* means in healthcare, it is apparent that the meaning of quality is influenced by the relevant discourse of society – where the meaning of "quality" two decades ago would probably not capture or reflect on what it means today.

The six dimensions have therefore since been reviewed and modified by the National Academy of Sciences, Engineering and Medicine (NASEM, 2018), but remain relevant to the current global context. These subtle modifications reflected the opinions and knowledge not widespread when the IOM (2001) report was originally published. For

example, one modification included changing the wording from “patient-centered” to “person-centered”, reflecting on the importance of organizing care around the needs and circumstances of both the patients, providers and families. The concepts of “accessibility” and “affordability” were also added to the dimension of “timeliness”, acknowledging the financial aspect of high-quality care (NASEM, 2018). Therefore, a widely accepted and influential framework for assessing health care, set forth by the IOM (2001) and subtly modified by NASEM (2018), defines quality according to the following six dimensions which are interrelated, and are both individually and collectively, essential properties of high-quality health care (IOM, 2001, p. 5-6; NASEM, 2018, p. 36):

- **Safety**: The avoidance of harm to patients from care that is intended to help them
- **Effectiveness**: Providing services based on scientific knowledge to all who could benefit while avoiding both overuse of inappropriate care and underuse of effective care
- **Person-centeredness**: Providing care that is respectful of and responsive to individual preferences, needs and values, and ensuring that people’s values guide all clinical decisions.
- **Accessibility**, **Timeliness**, **Affordability**: Reducing unwanted waits and harmful delays for both those who receive and those who provide care; reducing barriers and financial risk for patients, families, and communities; and promoting care that is affordable for the system
- **Efficiency**: Avoiding waste, including waste of equipment, supplies, ideas, and energy, and including waste resulting from poor management, fraud, corruption and abusive or negligent practices.
- **Equity**: Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status (IOM, 2001. P. 5-6; NASEM, 2018).

2.1.2. Building blocks for High-Quality Care

WHO (2010) provides a framework which explains the basic functions that health systems need regardless of how they are organised, to ensure high-quality care

delivery. According to the WHO (2010) health systems have to *provide services; develop health workers and other key resources; mobilize and allocate finances;* and ensure *health system leadership and governance* (also known as stewardship, which is about oversight and guidance of the whole system) all of which are needed to achieve high-quality outcomes (WHO, 2010; NASEM, 2018). These are expanded on below.

Service Delivery

Adequate health services are those that deliver safe, effective, and quality health interventions to those who need it, when needed, with as little waste as possible (Roberts et al., 2008; WHO, 2010). Good service delivery, therefore, has at least two components: availability and readiness. Service readiness depends on the presence of basic services, such as reliable power, adequate water, and sanitation; standard infection control precautions; and medical equipment (WHO, 2010). Health facilities require adequate quantity and quality of water sources to maintain a hygienic environment and deliver care optimally (Allegranzi et al., 2011). An adequate power supply is required for sterilisation, medication storage (WHO, 2018) the use of powered tools (Adair-Rohani et al., 2013) and information and communication technologies (Cronk and Bartram, 2018). High-quality health care also depends on functional medical and technological equipment, such as laboratory equipment, medical equipment, or information and communication technologies (NASEM, 2018).

Health Workforce

High-quality healthcare requires a well-performing workforce that works in ways that are responsive, fair and efficient, given the available resources and circumstances (Speybroeck et al., 2006; WHO, 2010). In order to achieve the best health outcomes possible, there needs to be sufficient numbers of staff, who are equitably distributed and who are competent, responsive and productive (Speybroeck et al., 2006; WHO, 2010). Additionally, for health systems to achieve high-quality healthcare consistently, the workforce needs to be adequately trained (Barker et al., 2017), adhere to policy and guidelines (Daniels et al., 2017), be accountable and present (Nishtar, 2010).

Access to Medicines

According to WHO (2007, p. 3), a well-functioning health system “ensures equitable access to essential medical products, vaccines and technologies of assured quality,

safety, efficacy and cost-effectiveness, and their scientifically sound and cost-effective use". If health systems cannot procure enough of the right medicines or if patients instead find substandard medications at nearby pharmacies, it is difficult for providers to deliver effective care (Dowling, 2011).

Health Financing

Health systems require a well-established financing system that raises adequate funds for health, "in ways that ensure people can use needed services and are protected from financial catastrophe or impoverishment associated with having to pay for them" (WHO, 2007, p. 3). Adequate financial resources are therefore required to ensure resources are procured and supplied appropriately, health services are readily available, and ultimately support providers and patients (NASEM, 2018).

Leadership and Governance

Leadership is vital for a healthcare organisation, both to optimise operations and to shape culture (McFadden et al., 2009). It involves ensuring that strategic policy frameworks exist and "are combined with effective oversight, coalition-building, the provision of appropriate regulations and incentives, attention to system-design, and accountability" (WHO, 2007, p. 3). Effective leadership is also essential for developing a safety culture and improved outcomes in healthcare (McFadden et al., 2009; Buckner et al., 2014). Organisational safety culture is defined as the various values, beliefs, behaviours and attitudes that people and organisations hold around ensuring safety (Katz-Navon et al., 2005; McFadden et al., 2009). Safety culture is an important prerequisite for safe outcomes as organisations with a strong safety culture, value safety and strive to make it their priority (Katz-Navon et al., 2005).

Furthermore, research links the commitment of leadership to safety culture through instilling a clear, supportive culture that is non-punitive, just, and supportive of those who have erred (Cohen et al., 2003; Feng, Acord, Cheng, Zeng, and Song, 2011). Empirical studies have found that fewer medical errors tend to occur in hospitals that embrace a culture of safety (Katz-Navon et al., 2005) and that a strong safety culture and safer outcomes are associated with effective forms of leadership (McFadden et al., 2004; McFadden et al., 2009).

Health systems, therefore, need to ensure that these building blocks are adequately met to appropriately enable high-quality care delivery (Carayon, 2009; WHO, 2010; Cresswell et al., 2013) and outcomes that are desirable to staff, patients and organisations (Carayon et al, 2006). For a system whose primary goal is to ensure high-quality healthcare delivery to improve and sustain public health, avoiding harm and ensuring safety to both staff and patients is paramount to its success (Donaldson, Corrigan, Kohn, 2000; Carayon et al., 2006). In fact, awareness of medical harm, and efforts to reduce it, are as old as medicine itself, dating back to the classic Hippocrates' statement "abstain from harming or wronging any man [human – authors addition]" (Miles, 2005, p. 144). Ensuring high-quality care delivery is thus essential for health systems to avoid adverse events and achieve patient safety (Vincent, 2006, 2010; Halligan and Zecevic, 2011; IOM, 2004; 2012; WHO, 2017).

2.1.3. Achieving Patient Safety

While patient safety is related to *quality of care*, it is not synonymous. Regardless of the definition, *safety* is one of the components of *quality* (NASEM, 2018), but other dimensions of care are needed to ensure that the care is *high-quality.* Furthermore, patient safety is necessary to enhance quality of care as it is primarily concerned with the avoidance and prevention of adverse outcomes, including medical errors and unsafe acts stemming from poor quality healthcare itself (Vincent, 2006). Over the past two decades, the increased effort towards achieving high-quality care and ensuring that health outcomes are safe and effective has been at the forefront of medical safety literature (IOM, 2003; WHO, 2017; Lee et al., 2019).

Vosper et al. (2018) define system safety as "the level of system performance required to keep the incidence of harm (and risk) as low as reasonably practicable" (p. 362). Patient safety, on the other hand, is defined by the United States National Patient Safety Foundation (Cooper et al., 2000) as "the avoidance, prevention and amelioration [improvements] of adverse events or injuries stemming from the process of healthcare" (Cooper et al., 2000, p. 40). Moreover, in light of health system goals, Cresswell and colleagues (2013; p.4) describe *patient safety* as a "product of highly complex sequence of actions by multiple people and technologies" where social and technical elements of a work system interact to produce processes that lead to outcomes. Furthermore, if the interactions between people, technology and

environments are not optimal then the risk of adverse events increases, which in turn presents risks to patient safety (Smith and Carayon, 1995, Carayon et al., 2006; Kleiner, 2008; Carayon, 2009; Cresswell et al., 2013).

2.1.4. Avoiding Adverse Incidents

The definition of an adverse event can vary. For example, an adverse event is defined as unintended injuries to patients caused by medical mismanagement, rather than the underlying condition of the patient, that results in prolonged hospitalization, disability or death (Brennen et al., 1991; Leape, 1991; Grober and Bohnen, 2005). Furthermore, in the United Kingdom (UK) National Health System (NHS) a patient safety incident is defined as "any unintended or unexpected incident which *could have* or *did* lead to harm for one or more patients receiving NHS funded healthcare" (National Patient Safety Agency (NPSA), 2004, p. 9). Patient safety incidents therefore include adverse events and errors that in some cases, may result in no harm, referred to as a near miss. WHO (2005, p. 6) defines a near miss as "an error that has the potential to cause an adverse event [such as patient harm] but fails to do so because of chance or because it is intercepted".

Despite being goal-oriented and safety critical (Wears, 2012), healthcare systems experience high levels of adverse events, such as patient safety incidents, near misses and medical errors caused from poor quality care in all global contexts (Kohn, 1999; IOM, 2001; Vincent, 2001; Bates and Singh, 2018).

2.2. Evidence of poor-quality care globally

Large-scale international reviews of patient charts from various High Income Countries (HICs) estimate that between 4% and 17% of hospital admissions are associated with adverse events. At least one- to two thirds of these are preventable through appropriate care design and management processes (Brennan et al., 1991; Bates et al., 1995; Thomas et al., 2000; Vincent et al., 2001; Davis et al., 2002; Baker et al., 2004; Sari et al., 2007; Soop et al., 2009; Zegers et al., 2009; Hernandez, 2012). Recent evidence sourced from WHO (2018) suggests that patient harm due to adverse healthcare events is one of the top 10 causes of death and disability in the world and within high-income contexts and it is estimated that 1 in 10 patients is harmed while receiving hospital care (Slawomirski et al., 2017).

More specifically, research emerging from hospitals in the UK demonstrate adverse event rates of approximately 10% of hospital admissions (Vincent et al., 2001; Sari et al., 2007; Williams et al., 2008; de Vries, Ramrattan, Smorenburg, Gouma and Boermeester, 2008; WHO, 2017), and of these, as much as 50% may be preventable (de Vries et al., 2008; WHO, 2017). Furthermore, in Sweden, it has been reported that 37.7% of healthcare records were associated with an adverse event, in which most (76.1%) occurred within patient homes (Schildmeijer et al., 2018).

Figure 1, taken from Rafter et al. (2015), highlights the occurrence of adverse incidents in hospital admissions across various HIC's, and that a significant number of these incidents may be preventable. This stems from how risks are managed and refers to how with appropriate system analysis, design (or redesign) and implementation, many occurrences may be prevented. The purpose of Figure 1 is to demonstrate the occurrence of adverse incidents within high-income contexts.

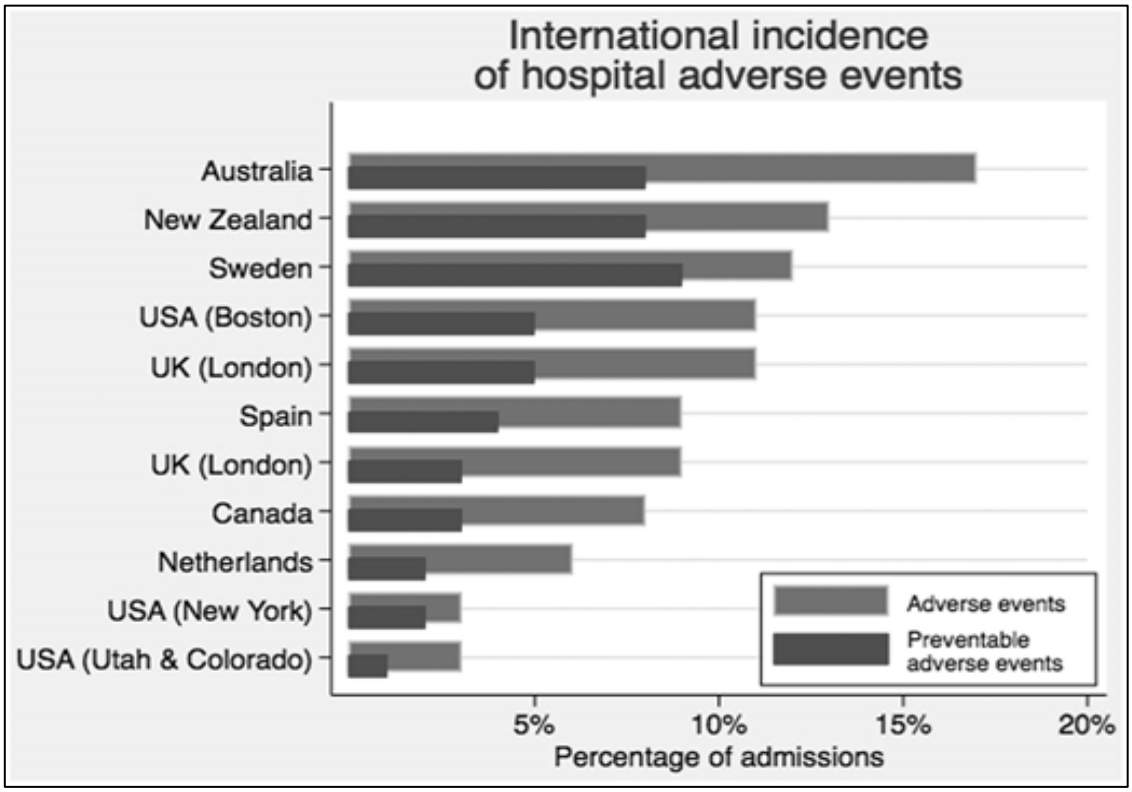


Figure 1. International Incidence of hospital events, taken with permission from Rafter et al. (2015). Licence number: 4855880743753.

2.2.1. Poor quality care in low- middle- income countries (LMICs)

In the context of low- to middle-income countries (LMICs), health systems face substantially greater risks of adverse events due to various challenges associated with socio-economic and political pressure, as well as limited resources, all of which limit the ability to ensure safe and effective care delivery (Wilson, 2012; Jha et al., 2013). In LMICs, occurrence rates and the associated mortality rates are accentuated by a lack of, or poor provision of resources or infrastructure that limit the ability to ensure safe and effective care delivery (WHO, 2008; Coovadia et al., 2009; WHO, 2010; Wilson, 2012; Managa, 2014; NASEM, 2018; Vaugh, Saint, Krein et al., 2019). The available evidence, according to the National Academy of Sciences, Engineering, and Medicine (NASEM, 2018), suggests that 13.4 million adverse events occur in hospitals in LMICs, contributing to 2.6 million deaths annually because of unsafe care.

Moreover, beyond the traumatic cost to human health, across LMICs, the cost of lost productivity alone due to poor quality care had been found to amount between $1.4 trillion and $1.6 trillion annually (WHO, 2008). Arguably, contexts with fewer resources can least afford the economic toll resulting from poor quality care (Wilson, 2012; NASEM, 2018). In many LMICs, the a lack of appropriate funding, the shortage or unequal distribution of equipment and resources and socio-economic factors in highly pressurised and complex systems, affect the ability of healthcare systems in these contexts to put in place adequate building blocks (WHO, 2007, 2010; Wilson, 2012; Jha et al., 2013; NASEM, 2018), which may ultimately affect the quality of care provided.

2.2.1.1. Evidence of poor building blocks within LMICs

In low- resource settings, such as many LMICs, both service readiness and availability are at risk (WHO, 2007; 2010). Many healthcare facilities in low-resource contexts lack adequate water, sanitation, and standard infection precautions (WHO, 2018). One study reported that out of 78 LMICs, 73% of health facilities lack sterilization equipment (Cronk and Bartram, 2018). Furthermore, a systematic review of hospital-acquired infections in LMICs found that inadequate environmental hygiene is a determinant of poor outcomes such as healthcare-associated infections (Allegranzi et al., 2011). Similarly, disruptions to power supplies at healthcare facilities are common in LMICs, which one study estimates occurrences in 59% of facilities (Cronk and Bartram, 2018).

A lack of reliable electricity disrupts healthcare delivery by preventing the use of sterilisation equipment, electrically powered tools (Adair-Rohani et al., 2013), information and communication technology (Cronk and Bartram, 2018) and refrigeration facilities, which can result in vaccine and medicine spoilage (WHO, 2018). A lack of electricity also impedes the capacity to provide both surgical care (Chawla et al., 2018) and services at night (Adair-Rohani et al., 2013).

Additionally, there is an estimated shortfall of 2.5 million doctors, 9 million nurses and midwives, and 6 million allied health professionals globally (Veld and Van De Voorde, 2014; WHO 2018). With few incentives to work in rural areas, many healthcare professionals often leave the LMICs in which they train for other, more profitable markets (NASEM, 2018). Additionally, Sub-Saharan Africa's health personnel-population ratios are among the lowest in the world, with notable maldistribution between rural and urban areas (Liese and Dussault, 2004).

Furthermore, a leading cause of poor health outcomes in LMICs is poor access to medicines, often due to inadequate or shortfalls in supply chains (Dowling, 2011). In Kenya, for example, a 2013 assessment on service availability and readiness found that a lack of availability of medicines affects care processes, while a lack of medicines results in the underuse of public health services (Kigen et al., 2013). If health organisations cannot obtain the right amount of the right medicines in time, or if patients instead find substandard medicines at nearby pharmacies, it is extremely difficult for providers to ensure adequate care delivery (Kigen et al., 2013). On the contrary, the overuse of medications and services has increasingly become a problem in many countries (Brownlee et al., 2017). Overuse of unnecessary services can harm patients physically and psychologically, and harm health systems by wasting often valuable and limited resources (Brownlee et al., 2017). Providing the appropriate and timely dosage of medication is therefore critical for ensuring health care quality.

With limited resources available, the majority of people living in LMICs are forced to delay treatment which exacerbates the fragmentation of the care they do receive and impairs their health outcomes (WHO, 2010; 2017; NASEM, 2018). Furthermore, without a sustainable source of funding, healthcare facilities can experience 'stock-outs', fail to deliver care that meets clinical guidelines or engage in unusual or unpredictable behaviour (Wilson, 2012; South African Health Review, 2019).

Moreover, a lack of spare parts often makes it impossible for healthcare facilities to maintain or repair medical equipment when out of service. As a result, equipment can sit unused in hospital hallways or in 'equipment graveyards' (Perry and Malkin, 2011). Across 16 LMICs, an average of about 40% of pieces of medical equipment in hospitals have been found to be non-functional (Perry and Malkin, 2011), compared with less than 1% in HICs (Howitt et al., 2012).

A further challenge for many countries is both the rapid turnover of leaders within health facilities, as well as many vacancies in leadership positions, as has been the case in South Africa (National Department of Health, 2007; 2011). Problems with leadership capacity at higher levels can limit the local performance of health systems in SA by limiting support, financial management and accountability (Siddle, 2011; Managa, 2014). In resource-constrained contexts, adequate leadership is critical because poor leadership capacity, support and financial mismanagement are associated with decreased performance and standards as they facilitate communication, financing, compliance, and support (Sarros et al., 2008; McFadden et al., 2009; Barker et al., 2017; WHO, 2018). Overall, these unfavourable building blocks result in excessive costs, a decline in efficiency and increased risk for poor quality care delivery, especially in LMICs (NASEM, 2018).

2.3. Contributing factors to poor quality care

The prevention and management of poor quality care through ensuring the necessary "building blocks" is influenced by the highly complex, unpredictable and dynamic nature of healthcare itself (Cook and Rassmussen, 2005; Carayon et al., 2006; Carayon, 2009; Karwowski, 2012; Hanefeld et al., 2017; Khan et al., 2018). Increasing work system *uncertainty* and *complexity* pose unique challenges to the people, or stakeholders (Dul et al., 2012) involved in the design, management and performance of health systems (Carayon et al., 2006; Carayon, 2009). It is therefore necessary to review concepts related to complexity and what makes healthcare systems complex.

2.3.1. Complexity in systems

A 'complex' system is defined as a collection of individual elements or components, with the freedom to act in ways that are not always predictable and whose actions are 'tightly coupled' (Cook and Rasmussen, 2005, p. 132) or interconnected so that one element's behaviour changes the context for other elements (Rutter et al., 2017). In

comparison to mechanical systems in which elements interact linearly to produce a predictable output, the components of complex systems interact non-linearly over multiple boundaries, and can produce unexpected results or emergent properties (Woods, 1988; Carayon et al., 2006; Rutter et al., 2017).

Furthermore, while the output of a mechanical system is predictable by manipulating each of its parts, the outputs of complex systems are dynamic, behaving differently according to initial conditions and feedback (Lipsitz, 2012; Rutter et al., 2017; Bar-Yam, 2019). By definition, examples of complex systems may include human immune systems (Varela and Coutinho, 1991), a colony of termites (Wilson, 1971), or any collection of interacting social and technical elements such as road transport systems (Larsen et al., 2010) and healthcare teams or organisations (Begun, Zimmerman, Dooley, 2003; Rutter et al., 2017).

To illustrate an example, Larsen et al. (2010) conceptualises complex systems in terms of road transport systems where road transport encompasses a large number of different elements, such as road users and designers, vehicles and road components that are subject to millions of random interactions daily. Furthermore, the characteristics of components are only partly predetermined - the system is 'open' to the environment in which it operates, meaning that it is influenced by and influences the environment, and outcomes (such as road safety) *emerge* as a result of interactions which are largely subject to the behaviours of road users (Cilliers and Spurrett, 1998; Larsen et al., 2010).

Before describing how issues of complexity contribute to challenges in healthcare quality management, the various characteristics of complex systems are discussed below. This is to facilitate an understanding of how complexity in terms of systems contributes to difficulty in managing poor quality outcomes.

2.3.1.1. Characteristics of complex systems

Walker et al. (2010) describes the main themes identified in literature around complex systems as those that have many interacting parts, referred to as multiplicity, and are characterised by change and dynamism and uncertainty (Walker et al., 2010). Complex systems are therefore characterised by several properties including *multiplicity, dynamism, uncertainty* (Woods, 1988; Holland, 1995; Walker et al., 2010;

Lipsitz, 2012) as well as *emergence, feedback and adaption (*Rutter et al., 2017, Dekker, 2016; Bar-Yam, 2019). These properties contribute to challenges to the design, performance and management of intervention strategies related to risks, safety and overall wellbeing (Woods, 1988; Dekker, 2011, 2013) and are briefly discussed below.

Emergence

A significant feature of complex systems is the concept of emergence (Johnson, 2006; Lindroos, 2009; Dekker, 2013; Wilson, 2014) where the behaviours and outcomes or emergent properties arise from the joint, non-linear interactions among components. The first notion of emergence in complex systems, as described by Wilson (2014) is that all systems in real use, under the constraints of space, time, management pressures and motivation, will display characteristics and operate in ways not expected or planned by the designers (Johnson, 2006; Wilson, 2014). The second type of emergent property is closely related to the first, in which the impact of poor designs may be mitigated through the well-recognised ability of users to find a way to make the system work, despite its limitations (Folke, 2006; Wilson, 2014; Gibson et al., 2016).

The idea of developing such system resilience is characterised in literature and refers to the ability for a system to adapt and persevere despite its shortcomings, and is a significant contributor to success despite the unpredictable and changing nature (Walker et al., 2004; Dekker, 2006; Gibson et al., 2017; Taysom and Crilly, 2017; Patriarca et al., 2018). Thirdly, there is the idea of emergence where people unexpectedly take advantage of capabilities in a product or role not imagined of by designers, or find new system uses (Johnson, 2006; Wilson, 2014). As emergent behaviours and properties are not apparent from analysing components in isolation (Dekker, 2013), but rather result from the interactions and relationships they form when coupled together in a system (Walker et al., 2010; Dekker, 2013), they are described throughout literature as ‘unexpected behaviours’ often not thought of by system designers (Bar-Yam, 2001; Johnson, 2006, Walker et al., 2010).

Multiplicity

Multiplicity refers to “a great number of interrelated and therefore interacting factors” (Marmaras et al., 1992. p. 1224). Complex systems with multiple people (Braarud, 2001), multiple tasks and processes (Sauer et al., 2000) have many potential causes

for external phenomena and multiple consequences (Maramaras et al., 1992; Walker et al., 2010). The many components of complex systems may therefore vary in number, size and relationships, all of which enables the opportunity for the occurrence of multiple phenomena and many consequences.

Dynamism

Dynamism refers to the extent to which complex systems change states (Woods, 1988; Dekker, 2011). The non-linear and 'open' nature of complex systems enables the characteristics of components and processes to change (Cilliers and Spurrett, 1998). 'Open systems' refer to systems whose elements influence and are influenced by the environment in which they operate (Cilliers and Spurrett, 1998). The characteristics of system components are therefore subject to affect the interactions ultimately changing the way the work is performed, either presenting or mitigating risks to the safety and performance of individuals involved. This may be the case if, for example, new laws are implemented, changes may occur throughout the work system that might either facilitate or limit safety and performance in other parts of the system.

Uncertainty

Uncertainty relates to the notion that having various dynamic and non-linear interactions among components makes it difficult to distinguish final states from initial conditions (Woods, 1988; DeMeyer et al., 2002). Uncertainty within complex systems is often likened to "fuzziness" where boundaries are unclear and dynamic and where components may be part of and interact with multiple systems simultaneously" (Karkowski and Ayoub, 1984; Plsek and Greenhalgh, 2001; Lee et al., 2003; Karwowski 2003; Flach et al., 2008; Wagenmakers et al., 2012)

The Bayesian quality of such complex systems, in which probabilities of outcomes are continuously updated as new information is continuously introduced (Hornberger, 2001), implies that a certain amount of 'irreducible uncertainty' will persist within the system (McDaniel, Lanham, Anderson, 2009). In other words, as more regulations are created, or as new technology is introduced, to control for the emergent and unpredictable behaviour of a complex system, the more the system may deviate from the desired outcome (Plsek, 2001).

Feedback

Feedback is an important feature of complex systems and describes the situation in which a change reinforces or balances future change (Bar-Yam, 2002). For example, in a healthcare context, the use of nametags on surgical headwear, termed the "theatre-cap-challenge" by Dr Rob Hackett (Jones, 2018) increases feedback by ensuring adequate communication between medical professionals, ultimately decreasing the risk of errors. Interventions like this also increase the convenience, and make such interventions or designs more appealing, further reinforcing the feedback loop (Jones, 2018). Complex systems require adequate feedback relating to enablers and disablers of performance, in order to learn from errors, and improve safety and performance (Bar-Yam, 2002; Walker et al., 2010; Dekker, 2011).

Adaption

Adaption is required by complex systems in order to achieve their goals and maintain safe and efficient outcomes (Walker, 2010; Dekker, 2011; Bar-Yam, 2012). *Adaption* refers to the adjustments in behaviour in response to the emergent feedback and consequences (Bar-Yam, 2012). For example, many complex systems are required to adapt and evolve at a fast pace through, for example, technological development in order to ensure that products and services provided are of the highest quality, assuming that the upgraded technology enables this (Cook and Rasmussen, 2005).

2.3.2. Complexity in healthcare systems

The abovementioned characteristics and properties of complex systems point to systems that are constantly evolving in unpredictable ways, where 'normal' operations present, move in and out of safe boundaries randomly (Cook and Rasmussen, 2005; Walker et al., 2010; Dekker, 2011), and where multiple boundaries decrease the certainty and predictability of outcomes (Cilliers and Spurrett, 1998).

In the case of healthcare systems, the complexities and resulting challenges have been discussed across the literature (Vincent, 1999; Plsek and Greenhalgh, 2001; Cook and Rasmussen 2005; Carayon et al., 2006; Carayon and Gurses 2008; Kleiner and Hendrick, 2008; Xie and Carayon, 2014; Carayon et al., 2020). For example, due to the varying size and structure of healthcare systems, delivering and receiving care is often associated with high levels of uncertainty (Woods, 1988; Bar-Yam, 2001). This is accompanied by ambiguity, where system boundaries are often unclear or separated

(Cook and Rasmussen 2005; Carayon and Gurses 2008), adding further to complications in designing and ensuring safe and effective healthcare (Plsek and Greenhalgh, 2001). Healthcare interactions occur over multiple boundaries, further increasing complexity and uncertainty (Carayon et al., 2006).

2.3.2.1. Multiple healthcare boundaries

Carayon (2006) elaborates on complexity in healthcare and how it may present challenges to the management and performance of these systems. These issues relate to the multiple, dynamic boundaries that interactions occur across, which can be *organisational, geographical, cultural and temporal* in nature (Friedman, 2005; Karsh and Alper, 2005; Carayon, 2006).

Organisational boundaries refer to healthcare interactions occurring across different *organisations* or institutions, for example, during care transitions or ordering of commodities. G*eographical* boundaries refer to when care is provided while patients and healthcare providers are in different locations, for example, with separated pharmacies or departments. Healthcare interactions also occur over *cultural* boundaries, where care is delivered across culturally diverse populations. Furthermore, healthcare interactions occur over *temporal* boundaries, for example, over work schedules and shifts, or where there is communication about care processes over time or where care is provided over an extended period of time (Karsh and Alper, 2005; Carayon, 2006; Carayon et al., 2006, 2015).

Working across organisational, geographical, cultural and temporal boundaries increases the number and type of possible interactions needed for healthcare to be safely and effectively delivered (Karsh and Alper, 2005; Carayon et al., 2006). Multiple boundaries amplify the complexity of a work system in which the level of complexity may, in part, refer to the degree of *differentiation* that exists within an organization (Damanpour, 1991; Mileti, Gillespoe, Haas, 1997; Greenhalgh et al., 2004; Kleiner and Hendrick, 2008).

2.3.2.2. Differentiation across boundaries

Differentiation refers to the multiplicity and diversity across system components, specifically the different boundaries and capabilities of the people that operate within the system (Holden et al., 2013). *Horizontal differentiation* refers to the degree of

departmentalization and job specialization within an organization. Division of labour creates specialists and departments, and how these specialists and departments are grouped is referred to as departmentalization (Roemer and Friedman, 1971; Mark et al., 1998). Healthcare organizations have a high degree departmentalization with multiple specialists, different wards and departments, such as radiology, pharmacy, maternal, orthopaedic, paediatric, each with many specialists interacting with patients simultaneously (Roth et al., 2017).

Vertical differentiation is defined by the number of hierarchical levels separating the Chief Executive Officer (CEO) position from the jobs directly involved with system outputs (Dewar and Hage, 1978; Kleiner and Hendrik, 2008). The more 'levels' that exist, the greater the differentiation exists between what is happening at the point of care and those who can address it (Kleiner and Hendrik, 2008; Shorrock, 2019). This raises two important concepts around the importance of acknowledging differentiation when managing risks and improving on safety in any complex system composed of humans - that being different *groups of stakeholders,* and the importance of understanding their different perspectives from the level at which they operate in a system.

Multiple Stakeholders

Dul et al. (2012) distinguishes between various stakeholders involved in the design and performance of systems (p. 386):

> *"System actors*, namely employees, and product / service users who are part of the system and who are directly or indirectly affected by its design, and who directly or indirectly, affect its performance.
> *System experts* are professionals such as engineers and psychologists who contribute to the *design* of the system based on their specific professional backgrounds.
> *System decision makers* (such as managers) make decisions about the requirements for system design, the purchasing and procurement of systems, and its implementation and use.
> *System influencers* such as media, governments, standardisation organisations, regulators or citizens who have general public interest in work system and product/service design."

These stakeholders exist and operate at different 'levels' in which their decisions and behaviours either directly or directly influence system performance (Dul et al., 2012). In order to mitigate risk, there needs be a clear understanding about the emergent challenges that result from the interactions between the people who exist and function within these various levels as decisions and behaviours by stakeholders at these various levels contribute to the provision of care.

Without appropriate knowledge around the challenges or risks to care delivery within a system, stakeholders, particularly decision-makers and influencers, cannot adequately address them (Rasmussen, 1997, Reason, 2000). This supports the importance of understanding vertical differentiation in managing complexities. Greater vertical differentiation across these levels increases the degree of complexity as it results in many lines of administrative, authoritative and clinical decision--making necessary to appropriately address challenges (Rasmussen, 1997; Roth et al., 2017).

Differentiation and multiple stakeholder perspectives

Rasmussen's (1997) Risk Management Framework for complex systems (RMF, figure 2), illustrates the typical 'bottom-up', 'top-down' feedback processes for managing risks. Rasmussen's (1997) RMF highlights the 'levels' of a system involved in the control of safety (Rasmussen, 1997). It is within these levels that various stakeholders exist and operate and contribute, either directly or indirectly, to the design, management or provision of care processes (Dul et al., 2012; Rasmussen, 1997).

The premise of the RMF (figure 2) is that in order to appropriately manage risks and safety in complex work systems, a coherent 'bottom-up' pathway of information related to pressures or changes needs to be *fed-back* or disseminated effectively across levels and stakeholders above (Rasmussen, 1997). Barriers to care are exacerbated by factors both at the clinical level, at the sharp-end, and at more upstream organisational and policy level, typically referred to as the blunt-end (Vincente, 1999; Reason, 2000). The RMF highlights the various 'system-level' pressures, which influence the emergence and management of risks and barriers. For example, at the level of work or the sharp-end, uncertainty, dynamism and complexity related to the fast pace change of technology may result in the emergence of hazardous processes, ultimately posing risks to sharp-end staff (figure 2, Rasmussen, 1997). Rasmussen (1997) argues that vertical integration of the information around these emergent hazards is

vital across these levels to appropriately respond to them and manage the associated risks. The point about understanding the views and experiences of stakeholders at different levels of a system relates to the concepts of Work-As-Done (WAD) and Work-As-Imagined (WAI) (Hollnagel et al., 2015; 2016; Shorrock, 2019).

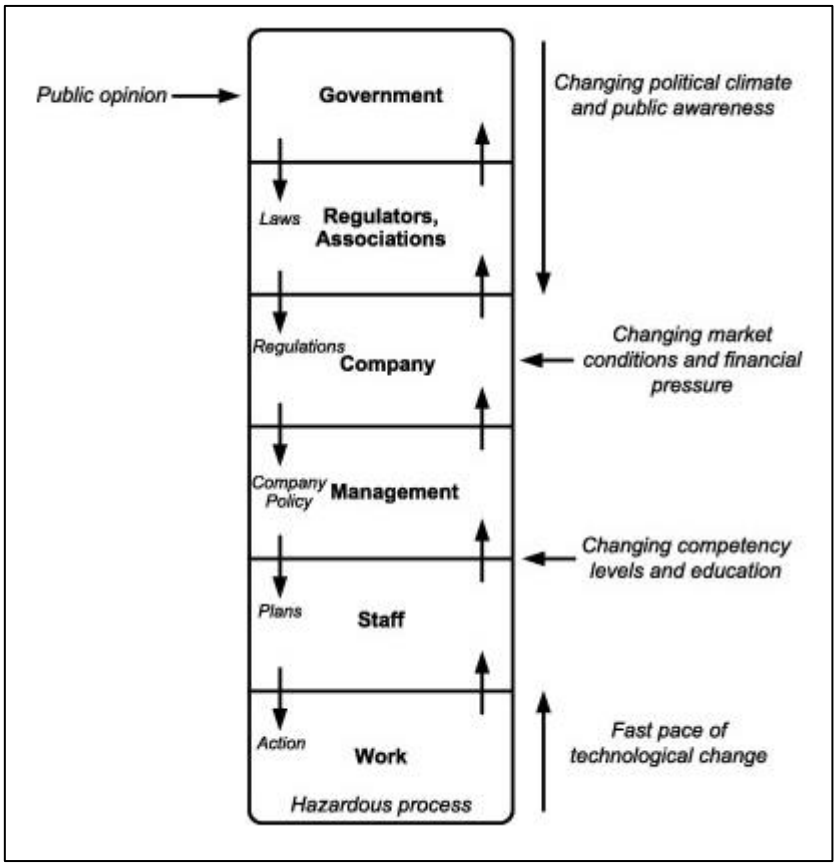


Figure 2. Rasmussen's risk management framework (RMF, 1997) depicting the levels of an organisation and the factors affecting decision-making and performance.

The concepts of WAD and WAI originate from the French Ergonomist, Leplat (1989) who distinguished the difference between task and activity in error analysis. Tasks refer to the prescription of actions needed in order to complete a goal while actions refer to the actual effort provided in order to complete the task. Typically, actions refer to how work is done while tasks refer to how work is expected to be done (Leplat, 1989). Subsequent literature and understanding into work systems analysis has resulted in the notion evolving into more contemporary views of work. Work as it is 'imagined' refers to the various assumptions that blunt-end staff have about how work

should be done (Hollnagel, 2016). Typically, the practical need to ‘imagine’ how work should be done occurs at the level of stakeholders who are removed from the actual work, at the ‘blunt-end’. Work is typically ‘imagined’ either when trying to improve existing conditions and approaches, during the design of equipment, tools, procedures and rules, as well as when thinking about managing, prescribing and scheduling operations and activities (Hollnagel et al., 2015, 2016; Shorrock, 2019). WAI is typically influenced by past experiences of WAD and exposure to work as it is disclosed (Hollnagel, 2016; Shorrock, 2019).

Work as it is ‘done’ (WAD) reflects the reality of operations and typically refers to descriptions of how work is actually performed from the perspective of stakeholders directly involved in processes and outcomes, either in a specific case, or routinely (Hollnagel et al., 2015). Work as it is done however, is not synonymous to how work is disclosed. Work as it is disclosed refers to what people say or write about work, and how well they do so (Shorrock, 2019). Work is disclosed by the people who do the work and those who do not, whereas WAD is characterised by the objective patterns of activity to achieve a particular purpose in a particular context.

Catchpole and Jeffcott (2016) wrote that in healthcare, “you will quickly find that there is a difference between policy and practice… and that administrators may not be aware of the latter“ (p. 184). Poor feedback, poor integration and sharing of information related to errors, conditions, barriers, challenges or changes across these various ‘organisational’ levels of stakeholders may create a disconnect between what is known at the sharp-end, and what is known at the blunt-end (Rasmussen, 1997, Reason, 2000; Hollnagel et al., 2015; Catchpole and Jeffcott, 2016; Shorrock, 2019). This is captured in the iceberg of ignorance model (Figure 3) by Yoshida (1989).

The iceberg of ignorance (figure 3) illustrates how this disconnect between how work is imagined and how work is actually done or disclosed leads to management’s failure to understand its processes and practices from the perspective of customers. The model suggests that as much as 4% problems are known to top managers while 100% of problems are known to sharp end workers, and those sharp end workers do not fully understand their connection in the system (to the bigger picture).

As mentioned above, the more 'levels' that exist results in greater vertical differentiation in which the stakeholders at each level have their own perspectives of what is happening at the point of care (where work is done). As each level has their own constraints and enabling factors (Rasmussen, 1997), as well as their own perspectives of what is happening at the point of care (Hollnagel et al., 2015; Shorrock, 2016; Shorrock, 2019), the functional purpose of these levels, be it to manage, develop policy, regulate or govern care processes, cannot address challenges without being appropriately informed. In the context of healthcare, a gap between how work is *done* by sharp-end workers, as compared to how it is *imagined* or *prescribed* (Shorrock, 2019) by blunt-end workers might be problematic as sharp-end stakeholders have an important role in the improvement of the healthcare system due to their vital role at the point of care (IOM, 2001). In order to close this gap, the challenges or barriers faced by workers at the sharp-end need to be appropriately understood and shared across the different levels. In other words, when designing and managing for improvements, the various perspectives around the challenges to work need to be appropriately shared across these 'levels' of stakeholders (Reason, 2000; Hollnagel et al., 2015; Shorrock, 2019), referred to by Rasmussen (1997) as vertical integration.

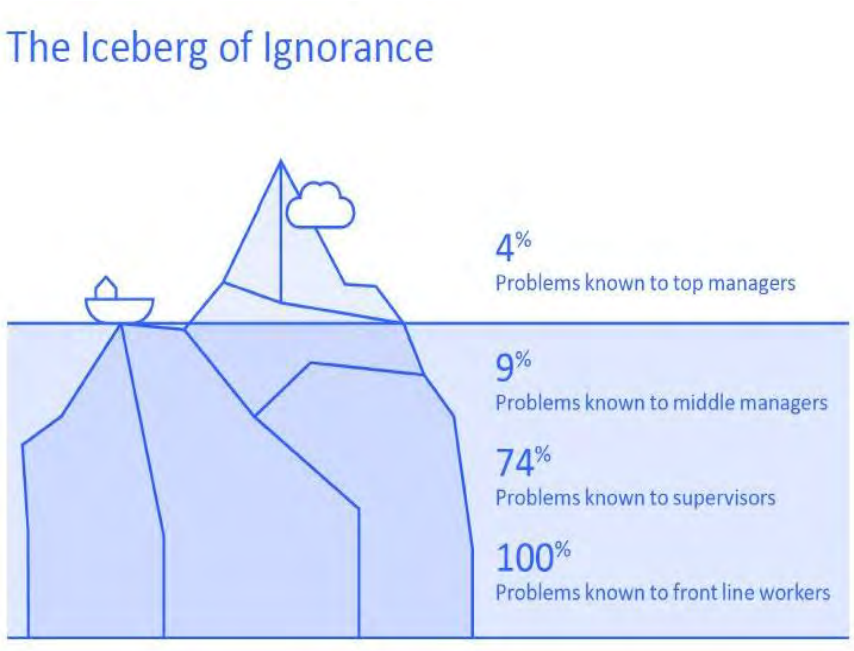


Figure 3. The iceberg of ignorance (Yoshida, 1989).

2.3.2.3. Fragmented care

Similar to differentiation, an additional challenge faced by healthcare related to the complexity of health systems and the multiple perspectives of stakeholders is that of fragmented care (NASEM, 2018). Healthcare delivery often requires patients to transfer across multiple boundaries of professionals, units or facilities, including patient homes, and those receiving care and information from a range of providers (Ben-Tovim et al., 2008). Due to many lines of decision making, due to vertical and horizontal differentiation and hierarchical structure, stakeholders often fail to communicate *effectively* with each other, or coordinate work, causing important information to be lost and impairing the ability to deliver care efficiently (WHO, 2008; NASEM, 2018). The failure of health systems to take into account the many clinical encounters, and instead treat each encounter in isolation, leads to care that is episodic, reactive, treatment-focused, and wasteful (NASEM, 2018). With many patients and providers lacking access to health records or important information, duplicate tests are often ordered or performed when people migrate across care providers and hospitals (Kripalani et al., 2007) and decisions are often misinformed or uninformed.

2.3.3. Contribution of complexity to poor care

In addition to the aforementioned macro contributors to complexity in health care systems, Vincente (1999) lists several, more specific factors that contribute to work system complexity that may influence high-quality care provision and outcomes. These dimensions of complexity and their relevance to healthcare are described in table 1.

Table 1 highlights complexities found in healthcare systems and how they contribute to difficulty in managing and ensuring high-quality outcomes (Vincente, 1999). These abovementioned complexities may result in the assurance and management of essential building blocks for quality care to be a challenge. For example, navigating and operating across many fragmented boundaries and departments increases the level of complexity where the performance of healthcare tasks and clinical encounters may be inaccessible or inappropriate, ultimately risking the patient safety, and the success of healthcare organisations (Carayon, 2009; Holden et al., 2013). The unpredictable and highly complex interactions result in difficulty for health organisations to ensure that information related to the occurrence of adverse events

and deterioration of quality care is adequately understood by the appropriate people and therefore addressed (Carayon, 2006; Xie and Carayon, 2014; Holden et al., 2013).

Table 1. Complexity of work systems further described by Vincente (1999). Table adapted from Carayon et al. (2006)

DIMENSIONS OF COMPLEXITY	DEFINITIONS	RELEVANCE TO HEALTHCARE
LARGE / GROWING PROBLEM SPACE	Many diverse system elements and pressures	Plethora of illnesses and increasing populations
SOCIAL SYSTEM	Composed of many stakeholders at different levels who must work in interconnected ways	Patients, doctors, managers, designers, families
HETEROGONOUS PERSPECTIVES	Social elements have different backgrounds and disciplines	Different cultures, values, and behaviours
DISTRIBUTED / FRAGMENTED SYSTEM	People located in different places, each with different perspectives	Home healthcare, departments, e-care
DYNAMIC SYSTEM	Delay in effects of actions	Changes in technology environment change procedures and standards
HAZARDOUS SAFETY CRITICAL SYSTEM	Catastrophic economic, public, social, environmental consequences	Medical errors
COUPLING	Highly coupled interacting sub-systems	Both tight and lose coupling
AUTOMATION	Highly automated systems	Radiology, pharmacy
UNCERTAIN DATA	Uncertainty in data available to workers	Transfer of information about patient characteristics
MEDIATED INTERACTION	System not directly observable by workers	Medical technologies (endoscopic technologies)
DISTURBANCES	Workers responsible for dealing with unanticipated events	Unanticipated events (changes in patient status, or disease outbreaks)

2.4. Management of quality care

As mentioned above, to ensure and improve on quality outcomes in healthcare, providers and organisations must ensure that the management of poor quality-related outcomes is adequate and appropriate. This can be achieved through the identification of the possible contributing factors, followed by the development and implementation

of interventions and measuring the efficacy of the interventions (Grober, Bohnen, 2005). Rasmussen's RMF (figure 2) highlights the importance of effective dissemination of information about various barriers, hazards and risks across different stakeholders, in order to effectively manage them (Rasmussen, 1997). One way in which organisations aim for effective "bottom-up" flow of information related to barriers or incidents and improvement of risk management is through effective reporting and learning systems (WHO, 2005).

Unfortunately, as discussed, the high rates of preventable adverse events and poor quality outcomes in various contexts suggest that the ensuring quality care, informed by learning from, mitigating, and improving upon barriers to its provision in most contexts is for the most part, inadequate. (Kohn et al., 1999; IOM, 2001; 2005; Jha et al., 2013; Wilson, 2012; 2015; Rafter et al., 2015; WHO, 2017; 2018; NASEM, 2018).

2.4.1. Incident reporting and learning systems

To improve on the management of quality care outcomes the IOM (Kohn et al., 1999; IOM, 2001) recommended that healthcare organisations establish incident reporting systems which are characteristic of High-Reliability Organisations (HROs). HROs are organisations that engage in extremely complex and often fast-paced activities while avoiding catastrophic error (Weik, 1987; La Porte, 1996; Roberts et al., 2001), an example of which is aviation (Dekker, 2010). Through the implementation of appropriate reporting systems, healthcare organisations can learn from adverse events, mitigate contributing factors, prevent future events and ultimately improve on patient safety (Kohn et al., 1999; IOM, 2001; Dekker, 2001; 2010; Holden, 2009).

In response to this recommendation, the implementation of incident reporting systems was proliferated and adapted among healthcare organisations, typically requiring workers to submit reports about situations in which patients had been harmed, or had the potential to be harmed (Kohn et al., 1999; IOM, 2001; Mitchell et al., 2016). Furthermore, reporting systems allow for patient safety concerns, hazards and or incidents to be captured and are meant to trigger action, communication, response, learning, and improvement (Health Quality Ontario, 2017). While incident reporting and learning systems have been shown to provide improvements (Stavropoulou et al., 2015), literature seems to suggest many barriers to the effective use of reporting systems (Health Quality Ontario, 2017). Furthermore, according to Battles and Stevens

(2009), there was little evidence that demonstrated incident reporting to be associated with delivering safer healthcare. The lack of improvements to healthcare outcomes from incident reporting is likely due to various limitations associated with incident reporting (Health Quality Ontario, 2017), such as a reluctance from healthcare practitioners to engage and report (Farley et al., 2008). According to literature, common barriers to effectively using reporting and learning systems by healthcare professionals include fear of blame, legal penalties, the perception that reporting does not improve patient safety, a lack of organisational support, or inadequate feedback and communication regarding previously submitted reports (Evans, Berry, Smith, 2006; Farley et al., 2008; Health Quality Ontario, 2017). Further reluctance to use incident reporting systems may be due to time constraints, a lack of clarity about what to report, as well as difficulties in using this information once (if) disseminated (Farley et al., 2008).

One of the reasons as to why the management of quality care is inadequate in healthcare is paradoxically due to how poor quality care delivery is managed when it inevitably occurs (Leape 1997; Reason, 2000; Dekker, 2001; Holden, 2009). Stakeholders may be reluctant to adhere to reporting because of how reports or incidents are approached, typically resulting in blame and discipline (Leape, 1994; Evans et al., 2006). This brings into focus the relevance of the 'person' versus systems approach to error and incidents.

2.4.2. Person versus Systems approach to incidents

The way in which adverse events or poor quality outcomes are approached often contributes to their mismanagement where the high standards of practice that are taught to practitioners are often reinforced in hospital practice by an unforgiving system of censure and discipline (Leape, 1997; Reason, 2000). For example, the bias to view errors as products of a linear chain of causation rather than the result of complex systemic interactions may lead investigators to identify human behaviours as the sole, proximal causes (Reason, 2000; Leape, 1997). As opposed to more comprehensive *systems* approaches (Reason, 2000; IOM, 2001), *person-based* approaches to error causation typically leads to a punitive culture of "blame and shame" which places significant pressure on individuals to cover up incidents rather than to admit and report on them (McIntyre and Popper, 1983; Reason, 2000; Dekker, 2001; Holden, 2009).

Person approach

The *person approach* views poor quality outcomes (errors or incidents) as the consequences of psychological factors in individuals such as abnormal mental processes including forgetfulness, inattention, poor motivation, carelessness, and negligence (Leape, 1997; Reason, 2000; Dekker, 2001; Holden, 2009). It views humans as the primary cause for many accidents, assumes that the system in which people work is safe and that success is intrinsic. It also holds that the main threat to safety comes from the inherent unreliability of people and that progress on safety can only be made by protecting the system from unreliable humans through appropriate selection, procedures, automation, training and discipline (Woods et al., 1994; Reason, 1997; Reason, 2004). The person-approach to error (Reason, 2000), often termed the 'old view' (Woods et al., 1994) has been criticised for its contribution to individualistic blame cultures within organisations (Reason, 1997; 2000; Dekker, 2002; Holden, 2009; Mitchel et al., 2016) which often results in poor reporting (McIntyre and Popper, 1983; Reason, 2000; Dekker, 2001; Holden, 2009).

It is argued that the 'person approach', and the associated bias to view accidents as a linear chain of causation, resulting in blame, should not be acceptable when accidents or errors do not have a single proximal cause but rather result from a combination of co-occurring events (Helander, 2006). Helander (2006) further argues that "the notion that the operator should be punished or personally made responsible is unwarranted, unless of course there is a clear violation of regulations" (p. 340). In safety management, "safety procedural violations" are defined as "deliberate departures from the rules that describe the safe or approved method of performing a particular task or job" (Lawton, 1998, p. 78). Furthermore, violations in safety protocol have been found to be prevalent in healthcare work (Alper et al., 2006; Amalberti et al., 2006; Alper and Karsh, 2009).

Catchpole (2013) describes these violations briefly:

> *Erroneous violations* – due to a lack of understanding or inexperience;
>
> *Exceptional violations* – when unusual circumstances require unusual responses;
>
> *Situational violations* – when the environment makes adherence difficult;
>
> *Routine violations* – when a shortcut is regularly taken;

Optimising violations – when there is desire to improve a work situation

(Reason, 1990; Catchpole, 2013; Reason et al., 1998; Lawton, 1998).

It is acknowledged that violations can therefore either be intentional or unintentional and provoke harm within the system or in some cases increase system safety (Reason et al., 1998; Amalberti et al., 2006). This has been referred to as a form of micro-resilience (Hollnagel et al., 2006) where resilience is "the characteristics of managing the organisation's activities to anticipate and circumvent threats to its existence and primary goals" (Hale and Heijer, 2006, p. 35). In some cases, violations can take the form of corruption, which is the abuse of entrusted power for private gain (Transparency International, 2013), which can result in large economic and ultimately quality losses (Chattopadhyay, 2013; Haroon, 2014; Habibov, 2016).

Systems approach

In contrast to the person approach, analysis of accidents in medicine (Woods et al., 1994; Reason, 1996; Leape, 1997; Nolan, 1998; IOM, 2001) and other safety-critical systems such as aviation (Simsekler et al., 2015) has led to a broader understanding of error causation which focuses less on the individuals involved and more on the pre-existing systemic factors that provide the conditions in which errors occur. The 'new view', also referred to as the *systems approach* to error (Reason, 2000) accounts for the complex interactions of multiple contributing factors, both at a systems level (for example in lines of communication, teamwork, policies and procedures); and an individual level (failures in data gathering, or a lack of knowledge) (Giardina et al., 2013).

The systems approach to error causation was initially proposed by Fitts and Jones (1947), who found and described how features of World War II aeroplane cockpit designs systematically influenced the way in which pilots made errors. Extending on this understanding, safety literature began to realise how trade-offs by people at the sharp-end where work is done are influenced by what happens at the blunt-end where work is designed and organised (Maurino et al., 1995; Reason 2000).

In light of this, the systems approach to error causation views human error as a symptom of trouble deeper in the broader system (Cook, Render, Woods, 2000; Reason, 2000). According to this approach, safety is not always inherent in systems;

people have to create it (Reason, 2000). Furthermore, according to this approach, human performance is systematically connected to features of system tools, tasks and operating environment, and progress on safety comes from understanding, optimising or balancing these interactions (Cook, Render, Woods, 2000; Reason, 2000).

2.5. Systemic nature of poor-quality care

The seminal reports by the IOM (Kohn et al., 1999; IOM, 2000) elaborated on the magnitude of poor-quality care and safety issues by highlighting the systemic contributions to poor-quality care. In response to these reports, literature on safety in healthcare has increasingly accepted the notion that the vast majority of quality issues and failures result from how the system is designed or has evolved, rather than solely poorly performing healthcare professionals (Nolan, 1998; Leape, 1997; Reason, 2000; Nolan, 2000; Carayon et al., 2006; Xie and Carayon, 2014).

Theory and evidence accumulated over the past half-century clearly indicates that the quality of care is determined far more by the design of systems in which people work and interact rather than by people themselves (Nolan, 1998; Leape, 1997; Reason, 2000; Nolan, 2000; IOM, 2001; 2005; Carayon et al., 2006; Holden, 2009; Xie and Carayon, 2014; Bates and Singh, 2018). Similarly, other safety-critical industries that have acknowledged this have had successes in safety improvements through the application of more proactive, *systems-based* approaches to identifying risks to provide more efficient and safer systems and ultimately improve on quality outcomes (Card et al. 2014; Waterson and Catchpole 2016).

As a result of acknowledging and recognising the systemic contribution to poor quality care, the IOM (2001, 2005) and medical safety literature (Hignett, 2003; Carayon, 2010; Holden et al., 2013; Hignett, Joes, Miller, Wolf, Modi et al., 2015; Rutter, Suvona, Glonti, Bibby et al., 2017; NASEM, 2018) has continuously advocated for the use of Human Factors and Ergonomics (HFE) to explore, understand and improve safety within healthcare systems. Through its comprehensive approaches to understanding and improving complex system interactions between technical and social elements, HFE aims to inform the design of systems to enable desirable outputs such as human safety and wellbeing and effective system performance (Rasmussen, 2000; Carayon et al., 2011; Wilson, 2015).

2.6. Human factors and Ergonomics

According to the International Ergonomics Association (IEA), Human Factors and Ergonomics (HFE) is the scientific discipline concerned with the understanding of the *interactions* among social and technical elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance (IEA, 2000). The systems typically of interest to HFE are therefore referred to as socio-technical systems. The relevant sociotechnical systems theory that underpins HFE will be expanded on below before elaborating on HFE's various approaches.

2.6.1. Socio-technical Systems

The term socio-technical system (STS) is used to refer to systems comprised of humans or social elements and technical elements (such as technology and organisations), from the small and simple to the large and highly complex (Clegg, 2000; Walker et al., 2010; Read et al., 2015).

Socio-technical systems theory emerged in the 1950s following the introduction of mechanisation in the United Kingdom (UK) coal mining industry (Trist and Bamforth, 1951). According to STS theory, the performance of a system, its processes, and the resulting outcomes, is heavily dependent on the interactions within and between these interconnected system elements (Carayon et al., 2006; Hettinger et al., 2015; Wilson, 2014). These elements mainly include humans as individuals or teams (social aspects) and technical aspects such as the tools and technologies, physical environments and organisational structures, all of which interact among another to produce processes and outcomes in the form of a service, product, or information (Smith and Carayon, 2000; Walker et al., 2008; Carayon, 2009). The social aspects have implications on the interactions within the system as they vary in roles, and positions, with each having different lines of decision-making with many factors that influence cognitive behaviours and performance (Bar-Yam, 2002. Militello et al., 2014). Furthermore, STS theory states that in order for system processes and outcomes to be both safe and effective, the interactions that occur among system elements need to be jointly optimised in light of the changing external environmental factors, such as political, social or economic factors, and their impact on work systems (Clegg, 2000; Walker et al., 2008; Carayon, 2009).

With humans being the source of complexity (Bar-Yam, 2002), authors have argued the importance of acknowledging and appreciating complexity theory (Dekker, 2013) as important factors for understanding the systems of focus to HFE (Walker et al., 2010). The qualities of complex systems, which have been outlined in above sections, include the need to understand the multiple parts and relationships, dynamic interactions, fuzzy boundaries, and emergent properties together with feedback and adaption mechanisms (Woods, 1988; Holland, 1995; Walker et al., 2010; Lipsitz, 2012; Dekker et al., 2013). These qualities or characteristics form part of and influence the interactions among socio- and technical- system components (Gosbee, 2002; Carayon et al., 2006; Wilson, 2014) by increasing system complexity and ultimately challenging the management and improvement of risks and poor quality outcomes.

2.6.2. Three core principles of HFE

According to Wilson (2014) and others (Carayon, 2009, 2015; Dul et al., 2012; Hignett, 2013), the premise of HFE is therefore to understand the interactions and relationships among STS, so to improve those interactions in real settings. To achieve this premise, HFE applies core principles (Dul et al., 2012) including *systems orientation, person-centeredness* and *design driven improvement* in order to understand *context-specific* interactions. In doing so, this may inform the design (or redesign) of interacting systems of people, machines, environments and devices of all kinds to improve overall system performance and human well-being (Human Factors and Ergonomics Society, 2012; Gosbee, 2002; Wilson, 2014; Wilson, 2015). These principles are discussed briefly below.

2.6.2.1. Systems orientation

As defined by Dul et al. (2012) a system is a set of interdependent components, each with their own functions and goals, that interact among one another to form a larger, more complex interconnected network, to achieve a larger purpose or goal (Dul et al., 2012). Several authors have noted that HFE is a systems discipline (Carayon et al, 2006; Dul et al., 2012; Wilson, 2014; Zink, 2014; Karsh et al., 2014) as the systems that HFE is interested in understanding, include humans, the tools they use and the tasks they perform, the environments in which they move and how their activities are organised. Furthermore, HFE's scope has traditionally spanned from "micro ergonomics" (*humans using a tool* or *human performing tasks)*, to "meso ergonomics"

(*humans as part of teams or departments)* (Karsh et al., 2014)*,* to larger and complex (macro ergonomics) systems such as *socio-technical systems* in which the *humans* are but one embedded [social] component that may form part of larger networks of organisations, regions, or the world (Rasmussen, 1997; Hendrick and Kleiner, 2002).

Regardless of the level at which a system can be understood and intervened at, the goal of an ergonomics approach is underpinned by a systems approach (Hignett, 2003; Carayon et al., 2006; Thatcher et al., 2018). It is therefore important to understand the interactions within work systems to allow for the simultaneous achievement of the individual employee and organisational goals where individual employees are able to perform optimally in a safe working environment while the organisation can grow market share and profitability (Hendrick, 1991; Waterson, 2013).

2.6.2.2. Person-centeredness

Person-centeredness refers to the notion that the person or group of people are central in a work system, as their behaviours and perceptions directly and/or indirectly contribute to outcomes (Dul et al., 2012; Wilson, 2014). This means that efforts must be taken to support all stakeholders involved, through the design of work environments and demands that fit their capabilities, limitations, performance needs and other characteristics (Rasmussen, 2000; Dul et al., 2012; Wilson, 2014).

2.6.2.3. Design Driven

HFE aims for design driven improvements where person-centered design of work structures and processes (systems-based design), when grounded in sound HFE practice and science (Wilson, 2014) can improve many important employee, customer and organisational outcomes (Wilson, 2014; Dul et al., 2012).

HFE's purpose, therefore, is to jointly optimise or *balance* (Smith and Carayon, 2000) the social and technical aspects of systems, in light of the environmental and organisational pressures and influences that contribute to system changes. This will enable the dual outcomes of HFE (Rasmussen, 2000; Smith and Carayon, 2000; Carayon et al., 2006; Carayon, 2009; Walker et al., 2008; Dul et al., 2012).

2.7. Human Factors and Ergonomics in Healthcare

The increase in the demand for HFE in healthcare can be traced to successes of HFE in other safety-critical industries such as mining, nuclear power (Meshkati, 1991),

manufacturing (Punnettet, 1998; Marras et al., 1993), and aviation (Sexton et al., 2000). Despite operating in hazardous contexts (Lwears, 2012; Sutcliffe et al., 2017), these industries have achieved high levels of reliability and improvements to safety management through the application of HFE (Meshkati, 1991; Sexton et al., 2000). Furthermore, the application of HFE in healthcare and patient safety is not new (Chapanis and Safrin, 1960) however, some authors argue that there has been little progress in adopting methods and guidelines for improving on healthcare processes and outcomes (Shekelle et al., 2013; Dixon-Woods et al., 2014; Bowie and Paterson-Brown, 2019).

Along with increasing levels of complexity, a prominent reason for this slow progress is the “medicalisation” of safety (Wears, 2015), where the expectation that healthcare professionals will perform perfectly, has resulted in a significant focus on addressing individual performance as opposed to system design (Woods et al., 1994; Reason, 2000). This “medicalisation” in health system design has contributed to the lack of engagement with HFE professionals (Wears, 2015). Peerally et al. (2016) commented on the failure to engage with professional expertise, where root cause analysis for adverse events will typically be conducted by local teams and not experts in accident and safety analysis who are proficient in systems thinking, Human Factors, cognitive interviewing, stakeholder engagement and data analysis that are characteristics of other high risk industries and HFE methods as mentioned above.

Although the application of HFE in healthcare has been slow and sporadic, and despite there being limited empirical information on HFE applications in healthcare systems redesign (Carayon, Xie, Kainfar, 2014), HFE continues to be recognised as important in the achievement of quality of care and patient safety (IOM, 2005; Gurses, Ozok, Provonost, 2012; Carayon, Alyousef, Xie, 2014; Hignett et al., 2018; Carayon et al., 2020).

As indicated by Norris (2012), HFE should be applied and integrated into the design, implementation and change management of socio-technical systems of healthcare. HFE-based system redesign differs from traditional quality improvement efforts in healthcare as they incorporate the three characteristics of HFE, outlined by Dul et al. (2012), which include a *systems perspective, person-centeredness* and *design driven approaches*.

With this, there have been areas of good practice (Xie and Carayon 2015; de Savigny and Adam, 2009; Magnussen, Vrangbaek, Saltman, 2009) where system analysis techniques have begun to uncover and resolve healthcare safety and process problems. Examples of this include, but are not limited to, the application of *Cognitive Task Analysis* to identify information requirements for using a patient-controlled analgesia pump (Lin et al., 1998), a *Workflow Analysis* to identify deficiencies of radiotherapy treatments delivery processes (Chan et al., 2010), a *Proactive Risk Assessment* to identify and address potential process failures (Reiling et al., 2004), *teaching* HFE knowledge related to safety and design (Reiling, et al., 2004; Hignett et al., 2018), the development of checklist prototypes based on HFE design principles (de Vries et al., 2009) and *participatory design* of an operating room scheduling system with the main focus on *usability* and *user acceptance* (Hasvold and Scholl, 2011). Moreover, Patterson et al. (2002) analysed the work of nurses using barcoded medication administration technology where a system analysis uncovered new side effects of the technology, including unexpected routes to adverse events.

Furthermore, research aimed at exploring context-specific stakeholder perceptions around barriers and facilitators to safe and effective care with system orientated frameworks has emerged from various health contexts (Ridelberg et al., 2014; Barker et al., 2017; Hignett et al., 2018; Abebe, Chui, 2018; Odberg et al., 2020). Understanding the factors that both limit and facilitate system performance may aid the design of interventions aimed at improving both safety and quality (Carayon et al., 2005). For instance, a study from a hospital in Sweden that used a systems framework developed by Vincente et al. (1998), explored what nurses perceived to be barriers and facilitators to patient safety. This gave a broad range of systemic factors that limit or facilitate patient safety, from the perspective of nurses (Ridelberg et al., 2014). The identified barriers to patient safety were associated with poor safety culture (related to leadership and incident reporting), work scheduling, financial resources, and communication with people external to the workplace. Furthermore, the systemic factors that facilitated patient safety were associated with individual skills and abilities and knowledge, written protocols, patient engagement and the use of information technology for collecting, storing and sharing of patient information (Ridelberg et al., 2014). It was suggested and encouraged that future research should consider the importance of both stakeholder perceptions; as well as system-based models for more

explicit understandings into problems and solutions as the perceptions of stakeholders are valuable in understanding the systemic factors (which either facilitate or limit performance) in a work system (Ridelberg et al., 2014).

Similarly, underpinned by HFE principles, Hignett et al. (2018) aimed to identify the perceived challenges to safe and effective healthcare within the National Health System (NHS). An important consideration of this study was on the demands and pressures of healthcare work and therefore, without the use of complex, resource-intensive systems-based tools, aimed to understand the systemic challenges faced by healthcare workers. The identified challenges included poor organisational culture, issues with staff numbers and competency, pressure at work, risk management, communication, resources, finance, and patient complexity (Hignett et al., 2018). Furthermore, these findings were used to guide and inform HFE-based workshops around raising awareness of HFE application in healthcare (Hignett et al., 2018). Learning outcomes of these workshops were in part to discuss HFE problems in terms of understanding capabilities as design challenges, and to discuss interventions in current systems through *redesign* rather than *adding work*. The details for this workshop are reported elsewhere (Hignett, 2015; The Health Education England, 2016) however, the findings indicate that using HFE approaches (system orientated and considering stakeholders perspectives) offer valuable opportunity to understand context-specific challenges from the perspective of sharp-end workers.

In summary, the application of HFE in understanding and improving quality of care and patient safety has been shown to, inter alia, reduce both task completion times, as well as complication, error and mortality rates (Johnson, Johnson and Zhang, 2005; de Vries, Prins et al., 2010; Chan et al., 2010; Preece et al., 2012). Additionally the application of HFE has improved staff compliance with best practices (de Vries et al., 2009; Lesselroth et al., 2013), and facilitated the identification and of various systemic barriers and facilitators to safe and effective work (Hignett et al., 2018; Ridelberg et al., 2014).

These findings support the application of system-based approaches, and importance of stakeholder perspectives and participation, in enabling a context-specific understanding of the challenges to safety in healthcare settings from various contexts (Xie and Carayon, 2015). Clearly, many different Human Factors tools and

methodologies, specifically those underpinned with systems analysis, can be used to better understand and improve healthcare delivery. Important to note however, is that many of the proposed and applied methods are considerably resource-intensive (Stanton et al., 2013), and many HFE methods, specifically in healthcare, need to thus consider the pressurised nature of healthcare work when attempting to understand and address safety and performance issues. Furthermore, the identification of barriers and facilitators has typically been from the perspective of sharp-end stakeholders (such as nurses) (Ridelberg et al., 2014; Hignett et al., 2018). In terms of effective HFE application (Carayon, 2009; Holden et al., 2013) and risk management (Rasmussen, 1997), a comprehensive system analysis should encourage and consider the perspectives of all stakeholders at multiple levels. Furthermore, effective systems analysis should consider understanding both system facilitators and barriers (Carayon et al., 2005).

2.7.1. Models and methods for understanding socio-technical systems

In order to understand the constraints and facilitators to the performance of socio-technical systems and to design for safer, more efficient systems, it is important for HFE to characterize these many elements and their interactions, clearly and concisely to identify areas for improvement or intervention. Recent reviews of the methods available for HFE practitioners, have demonstrated that a variety of methods and models have been proposed to define and describe elements of STS which enable the application of systemic thinking to organisational work problems (Stanton et al., 2013; Waterson et al., 2015; Salmon et al., 2016). These models and methods define elements differently, or focus on specific aspects (such as safety, errors or tasks), emphasise the need to understand interactions between people and elements of the system, as well as the broader environment, often in a participatory manner (Wilson, 2014; Van Eerd et al., 2016). This enables the identification and description of which, and how, the characteristics of system elements influence the performance and safety management of processes and outcomes (Rasmussen, 1997; 2000; Reason, 2000; Stanton et al., 2013; Salmon et al., 2016). While important to consider, a review of these methods and tools is beyond the scope of this thesis.

2.7.1.1. Work Systems Model

The Work System Model (Smith and Carayon, 1989) provides a way of describing all of the elements of a sociotechnical work system that affect workers' well-being and performance outcomes (figure 4).

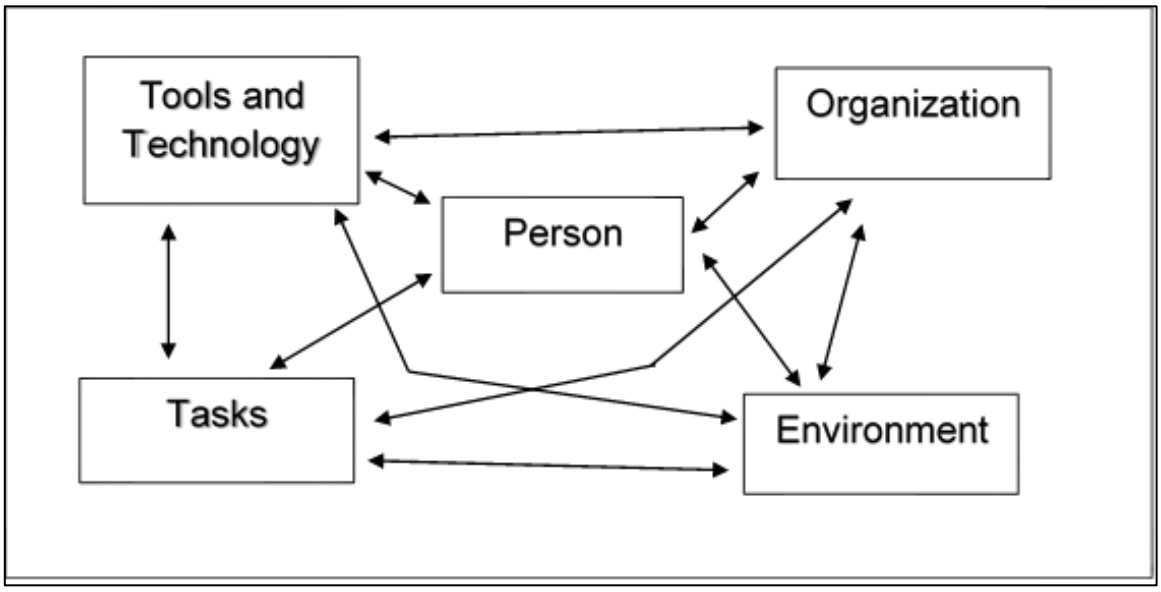


Figure 4. Socio-technical Work System Model, adapted from Smith and Carayon (1989)

The Work System Model offers a comprehensive understanding of the different elements of work and their interactions. According to this model (figure 4), a 'work system' is comprised of *individuals* (social systems, as individuals or teams) who interact *tools* and *technologies* (technical systems) to perform specific *tasks*; the tasks are performed in a physical *environment* and under specific *organisational* and social conditions (Smith and Carayon, 2000). These system elements are described in table 2. The emphasis of the Work Systems Model is therefore on understanding the interaction between humans and different parts of their system – and how the interactions between these elements influence both human wellbeing and performance and overall system performance (Smith and Carayon, 2000; Carayon, 2009).

Holden et al. (2013) suggest that there needs to be more work looking at multiple 'levels', including going beyond the single level, to capture the 'multi-level' nature of healthcare phenomena such as patient safety (Schutz, Counte and Meurer 2007). Furthermore, there has been growing recognition that healthcare phenomena at one

level, for example, in a clinical unit, operating room or patient home, are influenced by phenomena from levels above (e.g. the culture of the larger organisation, the community, or the decisions at leadership levels) and below (e.g. the skills or behaviours of individuals or teams) (Rasmussen, 1997; Hackman 2003; Begun et al., 2003; Karsh 2006).

Table 2. Work System components and design principles (taken from Carayon (2009))

Elements of the work system	Aspects of work system elements	Examples of models and theories on design principles
Person(s)	Psychosocial, cognitive and physical characteristics	Knowledge about the effect of aging n physical and cognitive characteristics
	Needs and abilities	Knowledge about expertise
	Demographic characteristics (age, sex, race)	Knowledge about cross cultural characteristics
	Experience	
	Cultural characteristics	
Task	Workload	Models and theories of job / organisational design such as job characteristics theory
	Job Control and Autonomy	
	Repetitiveness and variety	
	Job content and challenge	Models and theories of job stress such as the job strain model
	Rotation between tasks	
	Task completeness	Models of job rotation, job enlargement and job enrichment
	Task significance	
	Feedback	HFE Models of workload
	Ability to learn	
Tools and Technologies	Design of tools and technologies	Models and theories of usability
	Usability of tools and technologies	Knowledge about the physical ergonomic design or tools, technologies, and workstations
	Workstation design	
Physical Environment	Workspace design, layout of workspace	Knowledge about environmental conditions
	Noise, lighting, pollution, climate, vibration	

Organisational conditions	Social and organisational support	Models / theories of job / organisational design (e.g. participatory management)
	Role ambiguity and conflict	Models and theories of job stress (e.g. role theory)
	Job future and job security	Models and theories of teamwork
	organisational culture and climate	Knowledge about shift work and scheduling
	Participation	
	Teamwork	
	Work scheduling	
	Rewards and recognition	

Consequently, in the case of healthcare, the work system model has been applied widely by the HFE community, specifically in the development of a more comprehensive framework known as the Systems Engineering Initiative for Patient Safety (SEIPS) model (Carayon et al., 2006). The SEIPS model is a systems model that encompasses the Work Systems Model, complexity thinking, STS theory, quality improvement (Donabedian, 1988) and risk management to consider and present the many multilevel factors that contribute to healthcare and patient safety processes and outcomes (Carayon et al., 2006; Carayon 2009; Holden et al., 2013; Carayon et al., 2020). The SEIPS model serves as a comprehensive model for describing how these systemic factors might contribute to patient safety by considering the system-wide interactions at various levels and phenomena such as patient safety (Holden et al., 2013). It has been used extensively and has been shown to be of value in multiple studies (Karsh et al., 2004; Sittig and Singh, 2009; Gurses et al., 2010; Carayon et al., 2014; Xie and Carayon, 2015; Carayon et al., 2020).

The following section will, therefore, outline the contribution that HFE offers in understanding and addressing complex problems within healthcare systems. The section will briefly highlight how issues of complexity have shaped the development and application of the SEIPS model. The subsequent sections will conclude by highlighting how the application of the Work Systems Model (Smith and Carayon, 1989) as a framework for exploring systemic barriers is an important starting point to provide insights and guidance for future research aimed at understanding and

improving on systemic factors that contribute to patient safety processes and outcomes (Carayon et al., 2006).

2.7.2. Systems Initiative for Patient Safety (SEIPS)

The most effective and widely accepted models which has been designed for and applied to healthcare systems, is the Systems Engineering Initiative for Patient Safety (SEIPS, figure 5) model of work system and patient safety, proposed by Carayon et al. (2006). The SEIPS model, which was originally published in 2006, was proposed as a framework to improve the understanding of the systemic factors that contribute to patient safety (Carayon et al., 2006). The model is anchored in HFE as it is aligned with socio-technical systems design principles advocated by HFE experts (Dul et al., 2012; Wilson, 2014) where the *person* is at the *centre* of the work system; and the *interactions* among work system elements should be *designed* to support *performance and safety* outcomes (figure 5).

The SEIPS model integrates the Work Systems Model (figure 4), Donabedian's (1988) Structure-Process-Outcome (SPO) model of quality improvement, and socio-technical systems theory to describe how the structure of a health system contributes to the performance of care processes. The structure and the performance of the care processes determine the outcomes for both the patient and organisation, such as employee wellbeing, organisational profitability and turnover (Carayon et al., 2006; Carayon et al., 2014). The Work Systems Model (Smith and Carayon, 1989) is, therefore, a core component of the SEIPS model as it describes the 'structure' (Donabedian, 1988) of the health system, and how the design of these elements contributes to various processes and outcomes (figure 5, Carayon et al., 2006). These elements may, therefore, include the people; their tasks; the technologies used to perform those tasks; the physical environment in which the tasks are performed; and the context of the organization in which people perform the tasks individually or collectively as members of teams (Carayon et al., 2006) (Figure 5).

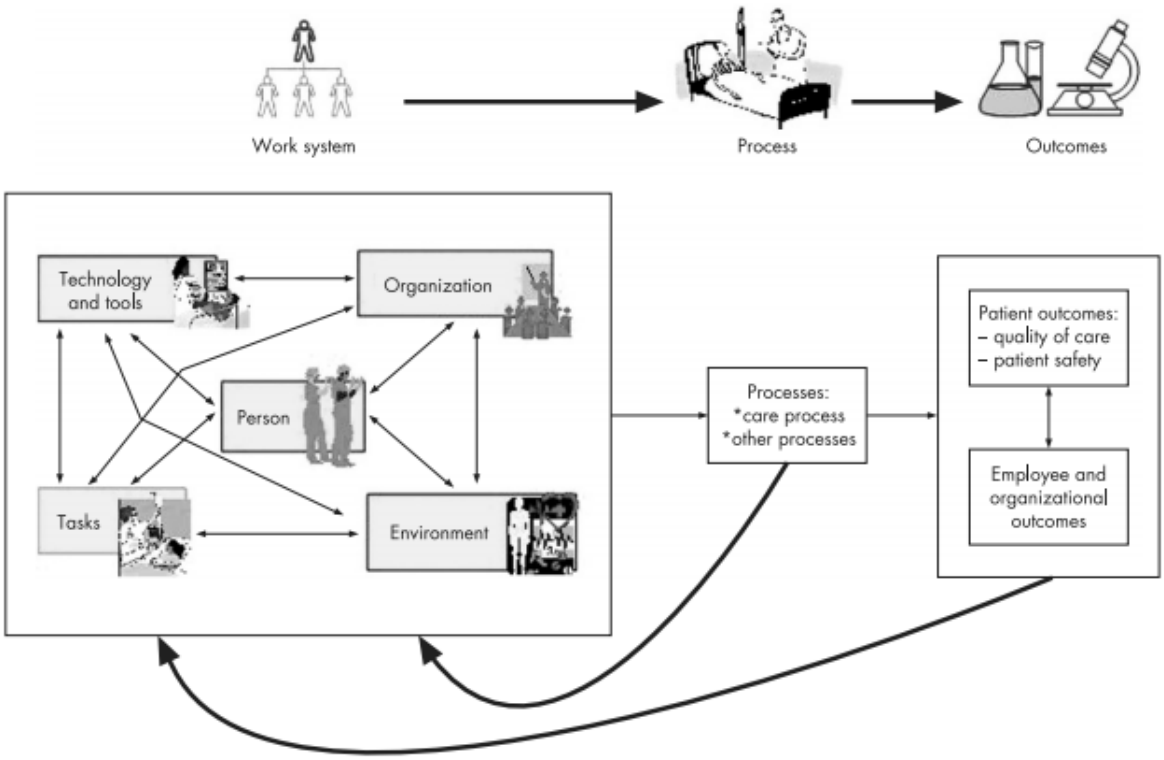


Figure 5. The system engineering initiative for patient safety (SEIPS) model conceptualising the sociotechnical health system by focusing on system design and its impact on processes and outcomes. (Taken with permission from Carayon et al. (2006), licence number: 4855901060134)

SEIPS model developments over the years

Since its publication in 2006, the SEIPS model has been updated in light of various considerations previously not made explicit when the original version was published (Carayon et al., 2006). The contributions of these relevant iterations will be briefly described below however for the onset of the document, the use of “SEIPS model” will be used in conjunction and refer to iterations of SEIPS 2.0 (Holden et al., 2013) and SEIPS 3.0 (Carayon et al., 2020).

The SEIPS model considers and enables understanding around the role of the external environment, various on feedback loops, as well as the active and adaptive role of humans (Carayon et al., 2014). The second iteration (SEIPS 2.0, Holden et al., 2013) emphasises the importance of understanding the *individual* and *collaborative* work of clinicians, patients, and caregivers. This enables the SEIPS model to consider that various *configurations* of work systems (where work systems are either centered

around patients, clinicians or teams) produce varying system barriers and facilitators. These in turn influence patient outcomes such as patient safety, clinician outcomes such as stress or burnout and organisational outcomes, such as turnover (Holden et al., 2013).

The third iteration (SEIPS 3.0, Carayon et al., 2020) enables the SEIPS model to expand on the process component and considers the concept of the *patient journey* to describe the differentiated and fragmented nature of processes, with system interactions occurring over multiple care settings and over time (Spacio-temporal considerations). The SEIPS 3.0 iteration also emphasises the importance of considering multiple perspectives (Carayon et al., 2020). The multiple perspectives that the SEIPS model considers, refers to the hierarchical and differentiated arrangement of the work system by distinguishing between individuals and teams under the person(s) component, between people and organizational factors and between the internal and external environments (Holden et al., 2013; Carayon et al., 2020). As described above, the notion of hierarchy is important in human factors research and practice (Rasmussen 1997; Hendrick 2002) as the various perspectives at different levels contributes either directly or indirectly to processes and outcomes (Rasmussen, 1997; Reason, 2000).

Recent iterations by Holden et al. (2013) and Carayon et al. (2020) therefore consider relevant factors not previously made explicit in the original version (Carayon et al., 2006) such as structure configurations, patient journeys and multiple perspectives of stakeholders, all of which are important to consider when attempting to improve on healthcare outcomes (Holden et al., 2013; Carayon et al., 2020).

2.7.3. SEIPS Model as a framework for system analysis

Using the Work Systems Model as an initial framework, and integrating in with the SEIPS model, safety engineers can target and design initiatives focusing on specific elements of the system to allow for a wide scope of application (Carayon et al., 2006; Carayon, 2009). For example, interventions can be focused around the ‘person’ such as addressing educational and developmental interventions to increase competency and capacity; and ‘team’ components, for example, to reduce confusion or miscommunication during surgery (Carayon et al., 2006; Carayon and Gurses, 2008; Carayon et al., 2014). Initiatives aimed at ‘tool and technology’ components may

include the redesign of tools and equipment to allow for efficient user interfaces, or reduce the probability of malfunctioning, while the 'environmental' component may be addressed through redesign of physical workplaces (Karsh and Alper, 2005). 'Organisational' factors may be addressed with more macro-approaches such as the redesign of regulatory or policy factors, or cultural and leadership interventions (Carayon et al., 2006; Carayon, 2009; Carayon et al., 2014).

Moreover, the applicability of SEIPS is extensive and flexible allows for a wide scope of application, ranging from the design and analysis of research and interventions spanning multiple healthcare delivery settings, from intensive care units (ICU's), paediatric care, cardiac operation rooms, outpatient surgery centres, primary care clinics and home health nursing (see Carayon et al., 2006; 2013; Gurses and Carayon, 2008; Carayon, 2009). The following section will therefore outline various application areas and findings of the SEIPS model and its value for future research and improvement efforts in healthcare contexts.

SEIPS application to healthcare

The SEIPS model has also been adopted by patient safety leaders (Provonost et al., 2009; Sittig and Singh, 2009; Gurses et al., 2010) and has been extensively used in patient safety research and education to teach HFE design principles and systemic considerations (Karsh et al., 2004; Hignett et al., 2018). The model has further been applied for extensive work system analysis, for example when identifying various performance and safety barriers among nurses and practitioners (Gurses and Carayon, 2007; Gurses, Carayon, and Wall, 2009) and within cardiac surgery (Gurses et al., 2012), as well as the key factors that shape medical therapy management (Chui, Mott and Maxwell, 2012). Furthermore, the SEIPS model has enabled the potential for the holistic identification of barriers and facilitators to: family engagement in bedside rounds (Carayon et al., 2011), information technology (IT) use by physicians (Holden, 2011), as well as factors affecting motivation and satisfaction of Tele-ICU nurses (Hoonakker, Carayon, McGuir et al., 2013).

Through the use of the SEIPS model in guiding a work system analysis aimed at identifying barriers to optimal medication administration processes in Norwegian nursing homes (Odberg et al., 2020), barriers were found in all work system elements, but most prevalent in the *tool and technology* and *task* components. These included

the poor usability and interface of technology and occurred in the early medication administration processes, ultimately hindering and interrupting workflow (Odberg et al., 2020). Researchers were thus able to point out potential ways of enhancing the work system interactions to provide a safer environment for medication administration in nursing homes (Odberg et al., 2020).

Furthermore, the application of the SEIPS model for mapping various barriers and facilitators to quality care delivery has been advocated by researchers for its comprehensive and illustrative nature in describing system interactions and outcomes in various contexts (Holden et al., 2013; Barker et al., 2017; Odberg et al., 2020). Barker et al. (2017) performed a qualitative study of barriers and facilitators to infection control practices in a tertiary hospital in India, using the SEIPS model as a conceptual framework. This study found that through the application of the SEIPS model, barriers related to staffing, leadership and training, together with workloads and unfriendly working environments, contributed to poor processes. These included poor adherence to information communication technology, hygiene practices and communication, all of which affected patient and organisational outcomes through increased infection rates, length of stay and costs of visits, increased hospital-wide infection rates and poor communication (Barker et al., 2017). This study further indicated that the use of the SEIPS model as a framework for identifying various barriers and facilitators to effective processes and outcomes from the perspective of healthcare workers, is valuable for informing the redesign of systems to address these problems holistically. In summary, the SEIPS model offers a comprehensive framework that conceptualises healthcare's complexity while allowing for the opportunity to holistically analyse, understand and improve on system-wide contributors to poor quality outcomes (Carayon et al., 2006; Carayon et al., 2020).

The use of the Work Systems Model for exploring and characterizing the systemic barriers to the provision of care is therefore, is an important starting point for understanding and improving on healthcare processes and outcomes (Carayon et al., 2006; Carayon, 2009; Carayon et al., 2014). By enabling a replicable and easily understandable solution to gaining comprehensive insights into what hinders and facilitates optimal work, the Work Systems Model, guided by HFE principles, can be applied in the analysis of various health work systems in order to address context-

specific challenges faced by stakeholders. In the context of South Africa, there is little known around the systemic factors which contribute to the assurance of quality care. Furthermore, Wilson (2014) argued that context is a key fundamental notion of HFE and that interactions can only be understood within a specific context. To date, there has been no research published on an HFE perspective of healthcare in the context of the Sarah Baartman District in the Eastern Cape of South Africa. High-quality healthcare provision is a challenge in South Africa and is affected by numerous factors related to the historical, political, and socio-economic context of the country (Coovadia et al., 2009). An understanding around the context of healthcare provision in the South African, and more specifically, the Eastern Cape is therefore outlined below.

2.8. Understanding healthcare provision in the South African context

Section 21 of the National Health Act, 2004 outlines the functions of the National Department of Health (NDOH) of South Africa as to: *implement the national health policy; issue guidelines for the implementation of health policy*; *and issue and promote adherence to norms and standards on emergent health matters.* These functions and the relevant policy, although broadly defined here, are core to the National Development Plan with strategic targets aimed at the development, promotion and sustainability of public health (South African Government, 2017).

2.8.1. Structure of the South African health system

The South African Health System is organised at national, provincial, and local / district levels, each with legislative and executive authority in their own spheres. Operating at both national and provincial levels ('spheres') are provincial governments, drawn from South Africa's traditional leaders. As stated in the Constitution (South Africa's supreme law), these bodies serve to advise the national government through a system of 'co-operative government'. South Africa has nine provinces (figure 6), each with its own provincial government to serve this (South African Government: SAGov, 2018).

2.8.1.1. Eastern Cape Province

Serving as the executive and legislative department assigned to address health matters within the Eastern Cape Province, is the Eastern Cape Department of Health (ECDoH). The ECDoH aims to achieve quality of healthcare for all within the Eastern Cape region of South Africa (ECDoH Report, 2018; ECGov, 2017). The mission of the Eastern Cape Department of Health is to provide and ensure accessible,

comprehensive, integrated services in the Eastern Cape (figure 6), emphasising the primary health care approach, optimally utilising all resources to enable all its present and future generations to enjoy health and quality of life (ECDoH Report, 2018).

Demographic profile of the Eastern Cape province

According to the ECDoH report (2018), the Eastern Cape (EC) Province has a total population of 6 522 734 people constituted mostly of a younger population where approximately 24.7% of the provincial population is made up of people between 20-35 years of age. Furthermore, the capacity of the EC health department is usually overstretched due to the high demand for essential services like education, health care services, social services, and housing (ECDoH Report, 2018). Poverty, unemployment, poor education, insufficient housing, access to piped water and sanitation are the social determinants of health that characterize the EC Province (ECDoH Report, 2018).

Figure 6. Map of South Africa's nine provinces, retrieved from http://www.southafrica-canada.ca/south-africas-nine-provinces/

Scope of the Eastern Cape government

Provincial governments are further broken down into local government consisting of municipalities of various types. Municipalities can be categorised as metropolitan, districts or local. Within a province, metropolitan municipalities govern the largest metropolitan areas, while the rest of the province is divided into district municipalities, each of which consisting of several local municipalities (SAGov). Local municipalities' share authority with the district municipality under which they are situated (SAGov). In other words, metropolitan and district municipalities form the layer of governments directly below the provinces. In the Eastern Cape province (figure 7), these include two Metropolitan Municipalities (Nelson Mandela Bay and Buffalo City) and five district municipalities (Alfred Nzo, Amathole, **Sarah Baartman** (Formally Cacadu), Chris Hani and O.R. Tambo district municipality) (SAGov, 2018).

Figure 7. Map of the Eastern Cape districts and municipalities. Focus area circled. Retrieved from https://en.wikipedia.org/wiki/List_of_municipalities_in_the_Eastern_Cape.

A district health system is defined by the WHO (2007) as a network of primary healthcare (PHC) facilities that deliver a comprehensive range of promotive, preventative and curative health care services to a defined population with active participation of the community and under the supervision of a district hospital and district **health management team**. Furthermore, the process of strategic and / or operational planning of health services at the district level is performed by the district health management teams, and are ideally aligned with the national strategy / plan of which it is locally expressing (WHO, 2007). This reflects the highly fragmented, hierarchical and differentiated structure of the South African Health system where many lines of authority, levels of leadership, and areas/levels for clinical and design-based decisions are made. This adds to the overall complexity and difficulty to ensure high-quality services in the local system.

2.8.2. Challenges to Healthcare in South Africa

According to the National Guideline for Patient Safety Incident Reporting and Learning in the Public Health Sector of South Africa, national data on the occurrence of adverse incidents in public health establishments are currently unavailable (National Department of Health, 2017).

Prior to 1994 and democratization of the state, the South African (SA) health system was designed using a colonial model – that being a distinctive historical feature which could come to precede an abundance of inequalities in the years to follow. As such, the current state of the SA health system, discussed below, is reflective of the deep and complex history that has shaped its political, social and economic contexts of health (Coovadia et al., 2009).

Mirroring SA's deep-rooted historical inequalities is the fact that the hospital sector in SA is dually comprised of private and public sectors (Coovadia et al., 2009). The public-hospital sector, which caters for the majority of South Africans, faces lower human-resourcing ratios, financial constraints, and ageing infrastructure (NDoH, 2009; Coovadia et al., 2009). The majority of South Africans, who rely on the public health sector, still face the consequences of being socially, economically and politically disadvantaged during apartheid. These consequences include low socio-economic

statuses, high rates of poverty, and deterred educational opportunities (Bray et al., 2011) all of which are determinants for poor health. The private, for-profit hospital sector is well resourced and caters to a population that tends to be wealthier, urban and more likely to be formally employed (NDoH, 2009; Coovadia et al., 2009).

In 2009, the Lancet published a series analysing and examining South Africa's health system (Coovadia et al., 2009; Chopra et al., 2009; Karim et al., 2009; Mayosi et al., 2009; Seedat et al., 2009). This special issue highlighted that the persistent health disparities that have emerged from the 'structural and state-inspired' oppressive apartheid system had been inadequately addressed resulting in a poorly prepared health system (Sewankambo and Katamba, p. 958, 2009). Some of the consequences, for example, are the continual rise and burden of non-communicable diseases (NCDs), a lack of resources and unreliable infrastructure (Coovadia et al., 2009; Chopra et al., 2009; Bray et al., 2011), all of which pose as challenges to ensuring high-quality care.

Moreover, the public sector is responsible for approximately 80% of the population but is only allocated 40% of the total health expenditure, whereas the private sector is responsible for 20% of the population and consumes approximately 60% of the health expenditure (Hospital Association of South Africa, 2009; Pillay, 2009). Despite literature suggesting that increased resource availability, typical of private sector, is associated with better quality outcomes (WHO, 2007), there is evidence from studies analysing healthcare in government run (public) and private facilities which found poor quality outcomes across both dimensions (Berendes et al., 2011) with little differences between public and private facilities (Basu et al., 2012). Literature suggests that the public health sector of South Africa faces significant shortfalls to various building blocks (WHO, 2010) needed for high-quality care provision (National Department of Health, 2007; 2011; Eygelaar and Stellenburg, 2012; Managa, 2014; Mayeng and Wolvaardt, 2015

Medico-legal challenges in the Eastern Cape Province

Furthermore, In the Eastern Cape, evidence around adverse incidents and poor quality care delivery is limited. According to the ECDoH Report (2018), the department continues to be confronted by the increasing medico-legal claims that seek to undermine its concerted efforts to manage the occurrence of medico-legal fees. In 2018 the department overspent R446 million (~$27 million USD) as a result of budget

pressure caused by the payment of medico-legal claims (ECDoH Report, 2018). Despite these efforts, medico-legal claims remain the single biggest risk to the department of health and the province's financial stability. The medico legal claims experienced as a result of poor-quality care delivery in the Eastern Cape Province, may be the result of South Africa's unique historical, political and social context, which has contributed to many healthcare challenges outlined below.

2.8.2.1. Service delivery challenges in South Africa

Service readiness depends on the presence of basic services, such as reliable power, adequate water, and sanitation; standard infection control precautions; and medical equipment (WHO, 2007). Service delivery in SA is affected by issues of accessibly and availability of essential resources and commodities (Coovadia et al., 2009; Mayeng and Wolvaardt, 2015). For example, some healthcare contexts in the Western Cape face limited access to laptops and computers, affecting the performance of routine service delivery activities. Furthermore, poor internet access disrupts weak and slow procurement processes, exacerbating the usual practices of late ordering and late payment (Gibson et al., 2017). Moreover, many health facilities across private and public domains of SA experience poor levels of hygiene and sanitation (Mayeng and Wolvaardt, 2015), and poor infection control measures (National Department of health, 2011) further limiting effective service delivery.

2.8.2.2. Infrastructure challenges in South Africa

SA's inadequate and unreliable infrastructure contributes to poor service delivery by compromising safety and security, aggravating waiting times or crowding, or hindering staff and patient attitudes (National Department of Health, 2007; 2011). Furthermore, inadequate infrastructure and commodities limit the ability to replace or repair equipment, and in many public health facilities within SA, equipment is rendered useless as a result (DoH, 2007; Coovadia et al., 2009).

Furthermore, the state and layout of various facilities have been found to be poor in various parts of SA, resulting in poor maintenance, issues with workflow, dissatisfaction of staff and patients, overcrowding, and security (Heunis et al., 2006; NDoH, 2007; 2011; Klopper et al., 2015). Moreover, security and crime in healthcare facilities in SA is of concern to management staff, particularly in relation to the theft of

transport infrastructure, medicine and even babies, as well as violence to staff members (Leon et al., 2001).

Additionally, the EC province has deep rural areas with rough terrain, which affects access by rural communities to health facilities. The rough terrain results in poor road infrastructure, which affects the effectiveness and efficiency of facility maintenance and ambulances services to needy communities (ECDoH Report, 2018).

2.8.2.3. Healthcare workforce challenges in South Africa

At the same time, the public sector of SA experiences an acute shortage in health professionals (Eygelaar and Stellenburg, 2012; Mayeng and Wolvaardt, 2015). Since 1994, the health sector in South Africa has been affected by a staffing crisis which has been aggravated by several unfortunate policy decisions – such as the offer of voluntary severance packages to public sector staff that had the effect of moving (often skilled) staff out of the public sector. Additionally, there has also been a substantial decrease in the nurse-to-population ratio, from 149 public sector professional nurses per 100 000 population in 1998 to 110 per 100 000 population in 2007 (Day and Gray, 1998; 2007) which has resulted from the closure of many nursing colleges in the late 1990s. This acute shortage of healthcare professionals, possibly as a result of poor decisions regarding policy development / poor human resource management, has persisted in South Africa (Coovadia et al., 2009). Shortages of workforce in South Africa has resulted in healthcare professionals experiencing high workloads (Mayeng and Wolvaardt, 2015) and increased levels of fatigue where staff do not have the capacity to perform optimally (Ganesan et al., 2019) all of which contribute to poor quality care.

2.8.2.4. Medication availability in South Africa

Interrupted drug supplies, insufficient clinical services, and a lack of access to services further hamper the delivery of quality care in SA (Goudge et al., 2009). The non-availability of drugs, along with poor patient interactions, results in patients receiving inappropriate or inadequate care.

2.8.2.5. Leadership and governance challenges in South African healthcare

South African health facility managers routinely face instability (such as changes in governance structures and financing mechanisms) which contribute to difficulty in

ensuring safe cultures and appropriate levels of leadership (Gibson et al., 2017). Findings from Managa (2014) indicate that key obstacles to the performance of local and national levels of government in SA are problems with institutional capacity, corruption and financial mismanagement. Furthermore, a lack of accountability, corruption and misconduct amongst Department of Health officials has contributed to a failure in ensuring high-quality care delivery (Siddle, 2011).

Given the consequences of SA's unique and challenging history (specifically the dually composed health system), together with the abovementioned challenges present in SA, the provision of safe and effective care in SA healthcare systems remains inadequate and strained (National Department of Health, 2014).

2.9. Problem Summary

As outlined in the above literature review, for health systems to appropriately adjust and address the many emergent barriers, they need to be systematically analysed and addressed in a participatory and holistic manner.

The complex and pressurised nature, together with the differentiated and hierarchical structures that health systems in many contexts hold (Carayon et al., 2006; Holden, 2011; Holden et al., 2013), contributes to many challenges in ensuring high-quality health care delivery. When adverse health events inevitably occur (Leape, 1994) they need to be understood and learned from in order to ensure the safety of all the people, and the performance of the system going forward. Furthermore, in order to enable appropriate management of the risks, there needs to be effective vertical integration, where information about barriers and risks at the sharp-end, is effectively communicated so they can be addressed at the blunt-end (Rasmussen, 1997). Karsh and Colleagues have proposed a multilevel approach in the domain of patient safety, where different levels in healthcare organisation are related to, and/or nested and can affect patient care (Karsh and Brown, 2005; 2009). They have also argued the need to understand the different levels of the work system: the clinicians work system, the workgroup, the organisation and the industry (Holden and Karsh, 2009). A multilevel approach to understanding the work system is very important to begin to understand the complex system-level interactions that influence the psychosocial, cognitive and

physical workloads to which the individual is exposed, and the subsequent outcomes, at the various levels.

Furthermore, it is emphasised that safer practice can only come from acknowledging the potential for error and building in error reduction strategies at every level of the organisation (Leape 1994; Nolan, 2005; Needleman et al., 2016). It is important to acknowledge that change needs to come from all levels of the organisation, although, experts (Needleman et al., 2016) point to the underutilisation of the sharp-ends' experiences for system improvement. Exploring, identifying and understanding the perceptions, from different perspectives of within the local system, is important for the early stages of improvement strategies.

In South Africa, and specifically, the Eastern Cape, stakeholder perceptions at different levels around what limits the provision of safe and effective care in public health facilities from an HFE perspective is largely unknown. Therefore, applying HFE's participatory approach together with the Work Systems Model (Smith and Carayon, 1989) as a theoretical framework, may enable holistic insight into exploring and understanding the systemic factors that influence performance within the Sarah Baartman District of the Eastern Cape, and ultimately around South African healthcare provision. Due to the scope of the current research focusing on unfavourable systemic factors, this research attempts to apply principles and approaches drawn from HFE, and the Work Systems Model as a guiding framework, to explore and highlight the perceived barriers experienced by stakeholders at different levels in an Eastern Cape, but specifically, the Sarah Baartman District public health system.

Chapter 3

Methodology

3.1. Experimental Design

This study adopted a cross-sectional design, which was qualitative in nature, to explore the perceived challenges around the provision of safe and effective care in public clinics from the Sarah Baartman District, in the Eastern Cape (EC) province of South Africa.

A cross-sectional study design was chosen as the research involved different cohorts of healthcare stakeholders, at one specific point in time. Additionally, the research was qualitative in nature as the data of interest represents the subjective experiences and perceptions around the challenges to safe and effective care delivery from these stakeholders.

3.2. Study settings and preparations

3.2.1. Initial study preparations

Following email communications with the district pharmacy manager, herein referred to as the local collaborator (LC), from within the local Department of Health about the potential scope and aims of the project, various meetings were set up where the study aims, objectives and approaches were collaboratively discussed and agreed upon. Due to the nature and approach of HFE research, this process was participatory and iterative in order to appropriately develop and design the research aims and method based on the LC's perceived priorities for the local context.

3.2.1.1. Initial meetings with a local collaborator

The initial meetings, which consisted of the researchers and the LC, aimed at discussing a feasible and appropriate research focus and method, from the perspective [of management] within the system. Initial interactions with the LC, therefore, involved discussing potential areas of focus as well as introducing the LC to the principles and approaches adopted by HFE. A similar process was followed by Carayon et al. (2011) when attempting to design intervention processes to improve safety in outpatient surgeries

During the initial meetings with the LC, relevant theory related to the systems approach and the design-driven nature that HFE adopts in order to achieve its dual outcomes of safety and performance were introduced (Carayon, 2009; Dul et al., 2012; Wilson, 2014). This was achieved by introducing the work system model (Smith and Carayon, 1988, appendix B) and design principles (table 3, Carayon, 2009) to the LC. Using Rasmussen's Risk Management framework (1997) (appendix A), the LC was also appropriately introduced to theory that highlighted the importance of the various 'levels' of stakeholder, and the importance of considering these various perspectives when attempting to analyse, design or improve existing systems (Rasmussen, 1997; Reason, 2000).

Furthermore, during these discussions and in light of the various approaches and aims of HFE that were introduced, the LC emphasized the need to better understand the perceived risks and challenges faced by staff within the local Sarah Baartman district health care system. He stressed the importance of this to the management team as a way of trying to improve the working context of the local health care facilities, which in turn, may reduce medico-legal claims they face as a result of poor quality care in the local context. Consequently, the researchers proposed various methods for exploring and obtaining what different stakeholders perceive as risk or challenges.

These proposed methods were initially modelled on the study by Hignett et al. (2018), and included a survey aimed at exploring the perceived challenges or risks from different local stakeholders, the results from which would be integrated into a workshop. This would have required participating stakeholders to be assembled at the Department of Health to complete a survey, and followed by a workshop aimed at educating or enable systems thinking and the importance of considering the systemic contributions of various barriers that they had identified. Furthermore, the LC agreed that focusing on understanding and exploring the different perspectives of various stakeholders at different levels and what these stakeholders perceive as barriers or risks, was important. The LC ultimately agreed to serve as a 'vehicle' for access to the healthcare stakeholders. Initially, this involved meeting with local management to discuss the aims and approach of the study.

3.2.1.2. Collaborative meetings with healthcare management

Following the meetings with the LC, it important for the research team would need to consult with the district health management team. This meeting consisted of the LC, various management stakeholders from within the local department of health and the research team. A presentation was given (appendix C), the aim of which was to introduce the aims and objectives of HFE and how it related to the study, as well as to discuss concerns or considerations around the proposed methods. The work systems (Smith and Carayon, 1989) and RMF models (Rasmussen, 1997) were used to facilitate the understanding and theory behind the proposed research.

During this meeting, it was agreed that in light of the time and performance pressures of sharp-end stakeholders, the proposed data collection approach (explained above) should not be as time or resource-intensive as originally proposed. A few management stakeholders who were present, raised concerns about the inclusion of a workshop, where the logistics around assembling participants and administering surveys, followed by workshops, would be a challenge as participants would need to be transported from multiple facilities in order to participate. Concern was raised around the fact that the workshops may take too long, and that taking participants away from their work for too long would affect the functioning of each participating facility.

Therefore, after further discussion, it was agreed that instead of transporting participants to a central place (i.e. the Department of Health offices in Makhanda) to participate in a workshop, the researchers would visit the facilities to interact with staff and collect data. This allowed for more efficient data collection, as participants could be recruited and participate without having to leave the facility. Furthermore, in order to gain perspectives from stakeholders within district management levels from the local District office, it was agreed that the LC would distribute and administer surveys accordingly within the Local Department of Health to relevant management stakeholders. In response to the discussed time and performance pressures faced in the clinics, instead of a workshop around discussing the challenges to healthcare delivery, a shorter pre-survey presentation was offered to the participants at the clinics.

The new approach to data collection therefore consisted of visiting each facility, providing a short pre-survey presentation, and administering a short survey thereafter. The presentation introduced the study objectives and aims, while introducing the

participants to various HFE principles, specifically to allow participants to think of the systemic aspects of their work and how different parts of their work system may contribute to the barriers or risks. The details around the survey and pre-survey presentation are discussed below.

3.2.2. Research Survey

In response to the identified areas of interest of the DoH management and the methods of collecting data, a survey was developed that was based on the study by Hignett et al. (2018). The original survey by Hignett et al. (2018) asked various healthcare providers for the top five barriers, followed by a question about the most concerning / high priority barriers that they perceived to limit the provision of safe and effective care in the National Health System (NHS) of the United Kingdom (UK).

As the perceptions around challenges to healthcare delivery from an HFE perspective are largely unknown in a South African context, the survey was modified with the intention to explore a broader range of challenges (appendix F). Rather than only asking participants what they perceive to limit the national health system, as was the case in the Hignett et al. (2018) study, the adapted survey intended to explore the challenges that participants perceive to limit safe and effective healthcare at a national level and a local level. For the local level part of the survey, participants were asked to list challenges to the performance of their own work. Additionally, instead of asking participants for the top five challenges, the current survey was modified to ask participants to list **up to 10 challenges** for both **national** and **local** levels. By distinguishing between what different stakeholders perceive to limit healthcare delivery nationally and locally, insights into a possible disconnect, or lack thereof, between these perspectives may be explored. The survey (appendix F) therefore consisted of three sections, outlined below.

3.2.2.1. Section 1: participants demographics and job characteristics

Participant demographics, including age, sex, race, facility (where they work), years in the facility, job role (clinical as doctors, nurses or pharmacists; non-clinical such as maintenance, cleaning, management, executive or authoritative body, policy developers or designers), and years in the role (as experience) were obtained.

The *facility* in which the participant works was of interest for two main reasons. Firstly, as care is performed over multiple boundaries (specifically organisational and geographical boundaries), different clinics may experience different challenges, and thus the perceptions, or perspectives, held across the different clinics may differ. Although understanding and reporting on these facility specific challenges was not a direct objective/aim of the current study, having participants indicate which facility they work from would allow for a comparison of perceived challenges to be given across the different facilities, which would be important for the local Department to understand. This could also highlight how certain challenges may be specific to certain regions or facilities, which previously may not have been understood. This is important in highlighting the complexities associated with geographical dispersion, where challenges may differ across contexts or regions (Das, 2011). This, ultimately, may enable the local Department of Health to address specific challenges in specific facilities, while appreciating common challenges across the facilities.

Job role was an important indicator of what the participant's actual job was within the system. This information was important for the research as it indicated what participants were required to do in their job, and how they interact with care processes and patients. Most importantly, job role was used to categorise participants according to Rasmussen's (1997) RMF to indicate what 'level' in the organisation participants operated at. For example, job roles that directly contributed to care delivery, or where care meets the patient, were categorised as sharp-end stakeholders. Job roles that were less clinical and did not particularly have a direct contribution at the point of care delivery included management or safety officers. The stakeholders that did not have any contact with patients, such as non-clinical, legislative, executive staff, but did contribute to system performance and safety through designing and organising work and resource provision, were classified as blunt end stakeholders. This categorisation procedure was based on the active role that each participant performed and their interaction with the patient and / or care delivery process.

It is further acknowledged that certain jobs, even though operating at the sharp-end (such as cleaning, admin or maintenance staff), may be considered as blunt-end staff as they do not have direct contact with the patients. In the current study, however, it

was acknowledged that the presence of these stakeholders contributed to “sharp-end” procedures and processes, and were therefore referred to as sharp-end stakeholders.

3.2.2.2. Section 2: Perceived challenges to the provision of safe and effective care in South Africa (national challenges)

To explore what stakeholders perceived as national level challenges to the provision of safe and effective care within the public health system of South Africa, participants were asked the following question: *‘List up to 10 challenges which you think limits the provision of safe and effective care within South Africa’s public health system’*

This question pertained to the broader national health system, where participants reported what they perceived to challenge primary healthcare delivery in South Africa. To indicate what participants perceived as the most important / prioritised challenges to the provision of safe and effective care in South African public primary health facilities, participants were asked: ‘*Of these, which do you think is the most important?’.*

By understanding what different levels, or groups of stakeholder perceived as the highest priority, inferences into how different levels perceive the state of the South African health system could be made in order to guide appropriate strategies aimed at highlighting and removing any disconnects. Furthermore, it is acknowledged that a participant’s job or perspective may have limited their view of the broader systemic barriers where information about national barriers may have been influenced by their experiences of the local context. For example, certain nurses’ perceptions around what limits national healthcare delivery may be influenced by their local experiences, or their local experiences would inform their perceptions around what is happening nationally.

To gain insights into how different levels of stakeholder might approach addressing the most important or high priority challenge, participants were asked: ‘*How do you think this could be overcome?’* This was important for research as indicated how the various stakeholders perceive certain issues to be overcome or addressed, in a participatory manner (Van Eerd et al., 2016).

3.2.2.3. Section 3: Perceived challenges to own work (challenges to local work)

Similarly, Section 3 of the survey aimed to explore the perceived challenges, the highest priority challenges and proposed solutions from participants, but at a local context level and specifically at each participant's work level.

Section 3 asked participants to "*List up to 10 challenges which you think limits the ability to do your job*." This information was important because the decisions and actions stakeholders perform in their job, may contribute to system performance elsewhere in the system in their own facility. This could give an important overview of common and/or unique challenges faced by staff across different facilities.

Again, participants were asked: '*Of these, which do you think is most important?'* This offered insights into what different stakeholders perceive to be the most significant barriers, relevant to their job / level. Participants were then asked: '*How do you think this could be overcome?'* This suggested how different jobs / levels might approach the solutions to overcoming the challenges that they perceived to limit their work. These insights would give valuable insights into user-centered solutions to these local challenges faced by stakeholders in their work.

3.2.3. Study Setting

The Sarah Baartman District, located in the Eastern Cape Province of South Africa, consists of 16 public primary healthcare clinics, one of which had closed due to renovations during the data collection period. Additionally, one clinic was a challenge to access as the nursing staff in charge constantly rearranged meeting dates, stating that they were unable to make the available time. Consequently, due to time constraints, this facility had to be omitted from the current study. The study therefore comprised of 14 public primary health clinics and one district department office (relevant management from within Makana and Sarah Baartman Department of health). For a list of facilities (n=15), and the number of staff members recruited per facility, see appendix G. For a map of the geographical dispersion of the various clinics and department office buildings, see the star points in figure 8.

3.2.3.1. Participants

Participants (n=120) were recruited from within the Sarah Baartman public health system and consisted of stakeholders from public clinics with help from the abovementioned LC. Due to the pressurised system where staff is limited, and time is valuable, sampling was purposive in that different levels or groups of participants were purposively recruited, however sampled by the convenience of availability.

The short 3-part survey was thus distributed to health system staff members, who were readily available, from 14 public clinics and one District office, within the Sarah Baartman District, Eastern Cape, South Africa. The categorisation of stakeholders (into workgroups, or levels) was performed inductively after data collection, according to the job role field, which is reflected in the results.

3.3. Research protocol

3.3.1. Ethical considerations

Before the research protocol could commence, ethical clearance was granted from the Rhodes University Ethics Committee (ref: 447, appendix H) as well as the National Department of Health Research Committee (Ref: EC201907_021, appedix I) (National Health Research Database) and gatekeeper permission was obtained from the National Department of Health Research Committee.

3.3.2. Preparations for data collection

Once ethical clearance was granted and the researchers were permitted to approach the various clinics, the LC made contact with relevant head nurses at each facility and informed them of the researcher's intentions to visit them to request participation in the study. The LC set up dates and times for the researchers to visit the facilities so the staff could prepare in advance.

The LC then shared contact details of appropriate staff with the researchers in order to facilitate communication between researchers and clinics. This was to ensure that the LC was no longer a “middle man” and researchers were able to confirm or postpone meeting times according to the availability of the facility staff. This was useful, given that staff availability did sometimes change as a result of work demands around seeing many patients. For example, one clinic had rearranged the initial meeting times due to there not being enough staff available, while another clinic rearranged meeting dates

due to the overwhelming workloads on the initial date organized. Once dates were finalised and set, the researcher visited surrounding clinics and municipal offices within the Sarah Baartman District (figure 8) to engage with interested staff from the clinics.

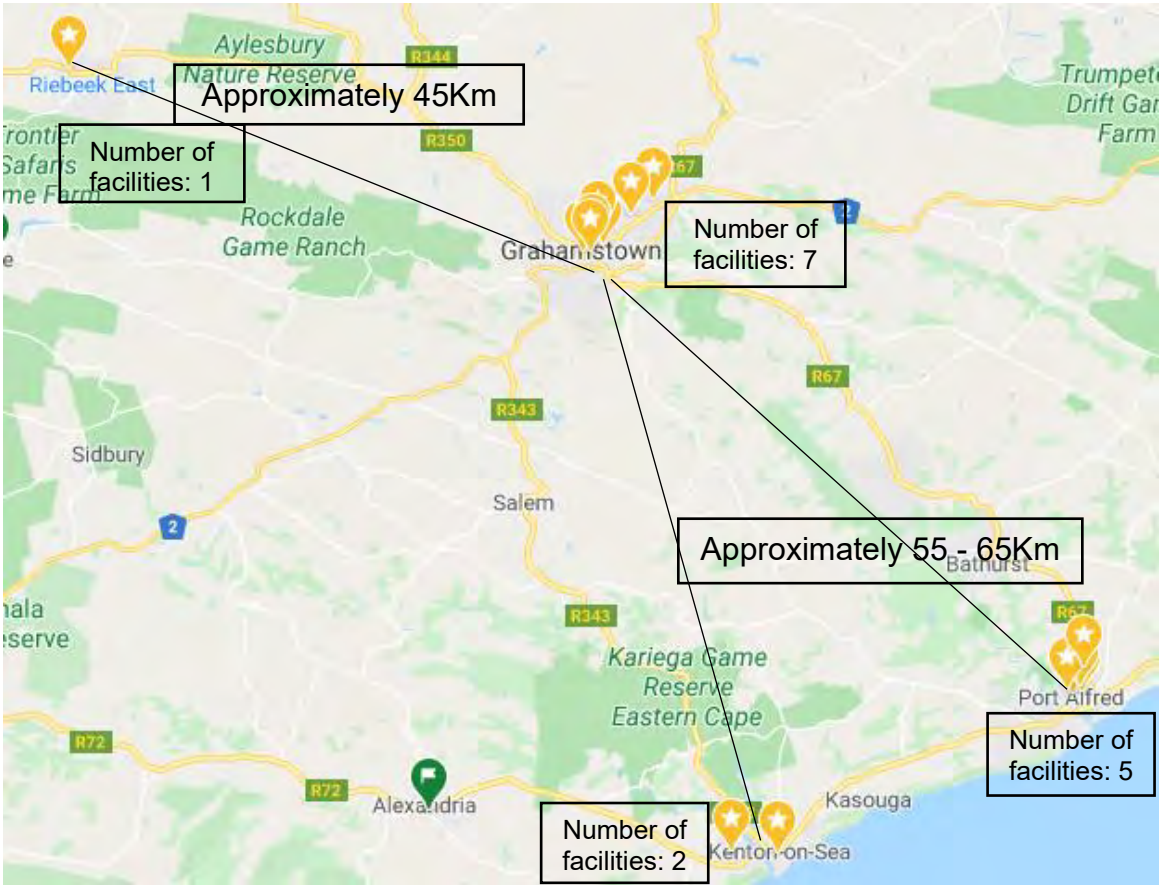


Figure 8. Dispersion of facilities (stars) within the Sarah Baartman district. Taken from Google, Map data: AfriGIS (Pty) Ltd 2020.

Upon arrival, head nurses gathered available staff members and a pre-survey presentation was given (appendix C). This presentation initially was intended to be supplemented with a PowerPoint / slideshow, however, during visits to the first two clinics, constraints around the limited space, unavailability of power plugs (either because the room did not have one or the rooms with electricity were occupied) it was decided that to offer an equal understanding, the slideshow was not to be used for any clinics. Rather, the researcher articulated and explained the relevant points to the staff members in the clinics. This “pre-survey” presentation aimed at introducing HFE and

the relevant concepts in order to allow participants to have an introduction to basic 'systems' understanding. The researcher explained the relevance of the Work Systems Model (Smith and Carayon, 1989) and highlighted the importance of understanding the interactions between system elements. By introducing ideas around how different parts of a system interact, and how various challenges may emerge as a result of these interactions, it was anticipated that participants would be able to think of the barriers from a systemic perspective. For example, when thinking about what parts of the work systems (the environment, people, tasks, organisation, or tools) may present barriers to the safe and effective care delivery in South Africa, nationally, and to their own work, locally which were previously not thought of.

Following this short (5 – 10-minute presentation), participants were offered the opportunity to raise concerns or questions pertaining to the study objectives or research. They were supplied a letter of information about the research and researchers (appendinx D). Participants were then informed of their anonymity, and consent was given to participate in the study (appendix E). On multiple occasions, various staff pointed out the concern that, for example, being the only data capturer from a specific facility would threaten their anonymity. The researchers emphasise that the data would be transcribed into a spreadsheet where anonymity would be ensured as only the researcher would have access to it, and results and data would not be correlated to specific surveys, participants or facilities.

The survey took roughly 20 minutes to complete, and participants were given time during the meeting to complete the surveys. In some instances, participants did not have time to complete surveys and were encouraged to complete them at a more convenient time while considering the pre-survey presentation. These surveys were then collected by the researcher from the relevant contact person in each facility and the participants were thanked for their participation.

3.4. Data Analysis

Each survey was reviewed for accuracy and completeness (Braun & Clarke, 2006). Incomplete surveys were not omitted. In cases where participants failed to complete fields, either by reporting less than ten challenges or not reporting on high priority challenges, or not reporting on race, age or sex, the available data was recorded regardless. If participants failed to indicate their race, or age, or sex, they were

categorised as “unassigned”. This was to ensure that all the challenges that were reported were accounted for, regardless of whether participants did not complete the whole survey.

In order to provide a rich thematic description of the entire data set, a thematic analysis was used to organise, describe and report on each stakeholder’s perceived challenges to the national and local provision of safe and effective care in SA and Sarah Baartman respectively. Thematic analysis holds benefits in its own rights as it provides a flexible and useful analytical tool, which can potentially provide rich and detailed, yet complex account of data (Braun and Clarke, 2006).

Thematic analysis is a method for identifying, analysing and reporting themes within data and therefore, section 2 and 3 of the survey were organised and analysed similarly, yet separately. Nvivo, a thematic analysis tool used to organise, analyse and find insights into unstructured qualitative data, was used for the analysis. Data was imported into Nvivo12 (https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home; with licencing granted from Rhodes University) using the survey import wizard, which organised, categorised and reduced the data for further analysis. Responses for section one were assigned as participant characteristics (attributes) while responses for section two and three were separately organised and into national and local perceptions respectively.

Responses from section two and three were grouped into ‘nodes’ where each sections questions (top 10 challenges, highest priority, and proposed solutions) were represented respectively. This resulted in two broad ‘nodes’ or ‘containers’ (Local and National), each with the three containers representing each question and respective responses, as ‘codes’. To facilitate an understanding of this process, please see a visual representation of this in appendix J.

With data sets organised accordingly into national and local perceptions, the analysis of each section consisted of two stages. The first stage used a structured analysis process to deductively categorize the data into work system components of the Work Systems Model (environmental, organisational, task, tools, person) according to Carayon (2009) design principles (table 3). This resulted in the reports from each section (local and national challenges) to be categorised into respective system

components. This was performed until all reported challenges, for each section were categorise into elements of the work system. The same process was repeated with the reported *high priority* challenges for each section.

Table 3. Work System components adapted from Carayon (2009)

Elements of the work system	Aspects of work system elements
Individual	Psychosocial, cognitive and physical characteristics
	Needs and abilities
	Demographic characteristics (age, sex, race)
	Experience
	Cultural characteristics
Task	Workload
	Job Control and Autonomy
	Repetitiveness and variety
	Job content and challenge
	Rotation between tasks
	Task completeness
	Task significance
	Feedback
	Ability to learn
Tools and Technologies	Design of tools and technologies
	Usability of tools and technologies
Physical Environment	Work station design
	Workspace design, the layout of workspace
	Noise, lighting, pollution, climate, vibration

Organisational conditions	Social and organisational support
	Role ambiguity and conflict
	Job future and job security
	organisational culture and climate
	Participation
	Teamwork
	Work scheduling
	Rewards and recognition

Responses around *proposed solutions* (for each section) were categorised according to emergent themes and common responses. The proposed solutions were not categorised as system challenges, rather they were categorized into separate themes inductively (see appendix K).

The second stage of analysis involved an iterative process of further coding reported barriers into themes within each broader system component. This process was performed according to Carayon (2009, table 3) as well as the researchers' discretion and understanding of the participant responses. For example, if a participant's response included difficulty communicating with patients due to language barriers, then this challenge was coded as a theme 'patients with different languages' under the 'Person' component of the Work Systems Model. If, however, responses included issues with communication between management and staff, this challenge was then coded as 'communication issues' under the 'organisational' component (table 3). This process was done for each question in each section (Q: 2.1; 2.2; 3.1; 3.2) until no new instances were found.

According to Braun and Clarke (2006), the ensure the rigour and reliability of the data, it is essential that researchers make sure their interpretations and analytical points are consistent with the data extracts and theoretical framework. To ensure the validity and reliability of the data and coding process, the data, specifically around the themes and their prevalence, were generated to an appropriate level of detail through an iterative process of discussions and decisions among the researcher and supervisors according to table 3. Equal time and effort was afforded to each of the emerging codes and

themes and it was emphasised among researchers that the data be appropriately interpreted rather than just described (Braun and Clarke, 2006). See appendix L for an example of how this process looked, referring to national reports, to facilitate understanding of this process.

Chapter 4

Results

The short three-part survey aimed at exploring perceptions around the barriers to safe and effective care in South Africa was distributed among various healthcare stakeholders (n = 120) from within the Sarah Baartman District, Eastern Cape province of South Africa. The survey consisted of three sections, namely to explore stakeholder demographics and job characteristics (section 1); the perceived barriers to national healthcare delivery (section 2), as well as perceived barriers to the performance of their own work (at the local level, section 3). The results of the data analysis will be presented according to each survey section.

4.1. Section 1 – Participants demographics

Participants (n=120) consisted of consenting healthcare stakeholders from 14 primary health facilities and one district department office. A list of facilities (n=15) and participant numbers per facility can found in appendix G. Participants were placed into workgroups according to occupation and job role, as seen in table 4.

In the following section (4.2), the perceived barriers to national healthcare are first described according to the components of the work system in which they were categorised into in order to facilitate a systemic understanding of the perceived barriers. This is followed by an overview of the barriers that were reported as high priority and the proposed solutions. In order to understand what different groups of stakeholders perceive to limit national healthcare delivery, the perceived barriers are the presented by *workgroup* thereby allowing for insights into the different perspectives around what limits national healthcare delivery from each stakeholder group.

Table 4. Participant work group characteristics.

Work Group (n)	Description of job role	Definitive Roles (n)	Average Age (SD)	Sex		
				n = male	n = female	n = unassigned
CHBC (n=45)	Community-Home-Based-Care workers provide basic care to patients by visiting community homes, educating community members	Home Based Care (n = 15); Community Health Workers (n=12); HIV & Lay counsellors (n=11); Peer educators (n=7)	41.7 (SD=9.6)	4	41	0
Nurses (n=40)	Nurses provide primary care to patients that visit the facility and thus work primarily from within the facility.	Professional Nurses (n=34) Enrolled Nurses (n=4) Registered Nurses (n=2)	41.14 (SD=11.8)	4	35	1
Pharmacy (n=13)	Pharmacy staff work within facility pharmacies and are responsible for ordering and administering medication to patients	Pharmacist Assistant (n=8) Pharmacists (n=4) Responsible Pharmacist (n=1)	39.15 (SD=12.6)	0	13	0
Facility Admin (n=11)	Admin staff are responsible for more administrative work related to the facility	Data Capturers (n=6) Operational Managers (n=2) Admin Clerks (n=1) General Assistants (n=1) Learners (n=1)	39.8 (SD=9.9)	3	8	0
Facility Maintenance (n=6)	Participants whose responsibilities include maintenance and caretaking of the facility	Facility Caretakers (n=3) Cleaning staff (n=2) Security Officers (n=1)	43.6 (SD=9.4)	2	4	0
Management (n=5)	Managerial staff are responsible for organisational and administrative decision making and typically work from department offices, occasionally visiting facilities	Clinical Program manager (1) Medical doctor (1) HIV program manager (1) Clinic Supervisor (1) Pharmacy manager (1)	54.4 (SD=6.9)	1	4	0

4.2. Section 2 – Barriers reported to limit national healthcare delivery

From the 120 participants, 719 barriers to South African healthcare delivery were identified following analysis. A preliminary word cloud representing the 50 most frequent words (including stemmed words, for example combining transport and transportation, or short and shortages) around the barriers to SA healthcare is presented in figure 9.

Figure 9. Word cloud of top 50 most frequent words related to the perceived barriers to South African healthcare.

A Word cloud offers an understandable and presentable way of organising or describing the most frequent words reported and is a useful tool for preliminary insights into the dataset. Participants most frequently referred to "**shortage", "staff", "lack", "working", "equipment",** and "**resources"** indicating preliminary issues related to a shortage of human and material resources, as perceived most frequently by participants to limit the national provision of healthcare.

The 719 barriers were thematically analysed and categorised respectively into system components (i.e. organisational, environmental, tool and technology, task, and person-related factors) according to the components of the Work Systems Model (Smith and Carayon, 1989; Carayon, 2009; see table 3).

Across all workgroups, 52.4% of reports were categorised as organisational barriers; 23.5% as tool and technology-related; 10.4% as environmental; 7% as person-related; and 6.5% as task-related barriers (table 5). The most reported barriers, across all workgroups, for each system component, is shown in table 5, and examples of which are further described in text and supported with direct quotations from stakeholders. For a full comprehensive list of the reported barriers, and the associated quotations describing each is shown in appendix M.

Table 5. Most reported barriers to SA, per system-level component, across all workgroups.

System component (% of overall reports)	Most reported barriers to SA (total reports: 719)	Percentage coverage of overall reports
Organisational (52.4%, n=377)	Shortage of staff*	16.9% (n=122)
	Poor management and Leadership*	6.6% (n=48)
	Lack of Training*	4.4% (n=32)
	Shortage of facilities	3.8% (n=28)
	High number of patients	3.4% (n=25)
Tool & Technology (23.5%, n=169)	Lack of "Tools and Equipment"*	6.3% (n=45)
	Lack of medication*	4.3% (n=31)
	Shortage of "resources"	3.8% (n=27)
	Transport	3.1% (n=22)
Environment (10.4%, n=75)	Poor infrastructure*	4.3% (n=31)
	Facility too small	3.7% (n=27)
	Security	1.9% (n=14)
Person (7%, n=51)	Community health and Education	2.7% (n=19)
	Patient behaviours	1.6% (n=12)
	Patient variability	0.9% (n=6)
Task (6.5%, n=47)	High workloads	2.2% (n=16)
	High risk work	1.6% (n=12)
	Long waiting times	1.3% (n=9)

Note. The most reported barriers are annotated with asterisks (*).

Organisational barriers to national healthcare delivery

The most frequently reported barrier (perceived to limit healthcare at the national level) and categorised as an organisational factor, included a **shortage of staff***,* such as

healthcare practitioners, *cleaning staff*, and *security personnel.* Another organisational barrier was **poor levels of management and leadership**, captured by one participant when they commented: "*management not taking the time to visit and see the problems*". This was supported by a nurse who said, *"no support [and monitoring] is given from management"*. Additionally, reported organisational barriers included a **lack of training** for staff (table 5); one participant commented that *"skills are not developed where they should be"* while another stated that "*there are not enough training opportunities".* A **shortage of facilities** and **high numbers of patients** were also frequently reported barrier to national healthcare provision (table 5). One nurse, for example commented that "*patients from other facilities come to [her facility] due to patient overflow, making workloads higher*" when referring to national barriers.

Tool and technology-related barriers to national healthcare delivery

Tool and technology-related barriers included **a lack of tools and equipment** (table 5). To this end, 'tools and equipment' ranged from a variety of technical resources needed for high-quality service delivery. This was highlighted by a pharmacist who wrote "*a lack of computers affects [the] ability to dispense as manual dispensing is very time consuming"*, and a nurse who reported on "*not having enough equipment to deliver work as it is expected because of no equipment*". Various participants reported on a "*lack of transport*" to limit effective healthcare delivery due by limiting *"transport to patients' homes*". This was particularly relevant for CHBC workers. One management participant also identified transport availability as a barrier for management staff nationally as they need to "*visit surrounding facilities*" and therefore are unable to. A **lack of medication** was also frequently reported across all participants to limit the national provision of safe and effective care.

Environmental barriers to national healthcare delivery

Environmental-related barriers focused on issues related to **poor infrastructure**, such as facilities not being adequately suited for healthcare (table 5). One pharmacist indicated that "*[facilities are not] suitable, i.e. it used to be an old school building*". Poor infrastructure was also described by maintenance staff where "*big cracks in the walls*" and a *"steep stoep [walkway – researchers interpretation] that can cause problems during disasters*" were cited as some of the barriers, possibly experienced at the local level, however *thematically* perceived to limit the national provision of care. The **size**

of facilities, being *"too small for the community served",* was also reported by multiple participants across workgroups (table 5). Participants also frequently reported on **facility security** – which was described in a comment from one participant as "*poor security systems…" and "no fencing… …make facilities unsafe for staff and clients*".

Person-related barriers to national healthcare delivery

The most person-related barriers perceived by participants, included the perception of **poor levels of community health and education** (table 5). Various stakeholders reported on "*high levels of poverty"* while one commented on *"patients [being] uneducated regarding their own health*". This was supported by a CHBC worker who commented that "*ignorance of both health providers and communities*" in the sense that ignorance around healthcare limits the ability for health care to be effective. Moreover, **patient variability** was a commonly reported theme, for example, one participant reflected on the challenges associated with "*working with people from different backgrounds"*, while a pharmacist highlighted "*language barriers*" as a challenge related to patient variability. Lastly, a nurse added "*some patients being hard to understand*" as a barrier to effective healthcare delivery nationally.

Task-related barriers to national healthcare delivery

The most frequent barrier identified related to task factors, included **high workloads** (table 5) where one nursing staff reported on having to do "*too much writing work*" and in an admin staff's comment of "*overloading of work".* One participant stated that there is a lot of *"time wasted doing other people's work"* in the sense that shortage of staff and high numbers of patients undoubtedly contributes to high workloads. The second most reported task-related barrier included **high-risk work** where participants perceived the high-risk nature of their work, such as "*working in the community [which] is not safe",* captured in a reflection by one CHBC worker. Another example of high-risk work is indicated from one nurse's comment where *"dealing with patients who have lots of diseases like MDR [Multiple Drug Resistant] XDR [Extensively Drug Resistant] Tuberculosis*" and a CHBC worker's perception of "*walking door to door without protective gear".*

4.2.1. National barriers reported as high priority and proposed solutions

Participants were asked to report on the barrier that they perceive as High Priority (HP) to South African healthcare and how they think this can be overcome. As above, the

high priority barriers were thematically analysed and categorised according to each work system component. The overall coverage of each high priority barrier is shown in table 6, with the most reported barriers highlighted in red. The most frequent barriers perceived as high priority across all workgroups, included a **lack of staff (37,6%),** a **shortage of tools and equipment (13.7%)**; **job security (8.6%)** and **poor infrastructure (5.7%).** Table 6 reflects the most reported high priority barriers perceived by all workgroups to limit the delivery of high-quality healthcare in South Africa. Table 6 also includes examples of how participants propose to possibly overcome these barriers. These high priority barriers, along with participants proposed solutions are described in text below.

138 of the barriers to the South African health system were reported and perceived as high priority (table 6). The most frequently reported high priority barrier was a **shortage of staff** where *not having enough*, *well trained staff* significantly affects the South African health system and its ability to ensure effective care delivery. A common proposed solution to overcoming this barrier, is to simply employ more staff. One pharmacist proposed that "*government should hire more pharmacist assistants"* while one CHBC workers proposed that "*government needs to hire more people, especially for clinics with a big community"*. The majority of the proposed solutions to this barrier involved the perceptions that "*government must employ more nurses"*, as reported by a nurse.

Furthermore, some proposed solutions to reducing a shortage of staff, as indicated by two CHBC workers, is the "*absorption of contract workers into the health system"* where affording contract workers permanent positions might reduce the pressure of a limited workforce. Some participants proposed that employing qualified and competent healthcare practitioners and management would overcome a shortage of staff, as reflected in a comment from a pharmacist stating "*employ qualified health officials in management positions, nationally, provincially and locally". A*nother participant suggested that organisational factors could be improved "*by firing all the corrupt people in government and hiring more healthcare providers"* suggesting that staff-related issues, such as corrupt staff, and vacancies within management, are perceived by stakeholders as a high priority barrier to safe and effective healthcare delivery in South Africa (table 6).

Table 6. High priority barriers perceived to limit South African healthcare and the proposed solutions, the most reported of which represented in red.

High Priority Barriers (138 total reports)	Percentage of total High Priority barriers	Proposed solutions
Organisational		
Lack of staff*	**37.6**	"government must employ more staff"; "fill management and practitioner vacancies"
Job security*	**8.6**	"absorb contract workers into permanent jobs" – nurse; "permanent employment from the department of health" – CHBC worker
Poor Budget management	2.8	
Poor management and leadership	3.6	"provide training for management"; "employ competent leadership and management"
Lack of facilities	5	"government must build more clinics"
Tool and Technology		
Shortage of tools and equipment*	**13.7**	"government to provide equipment and transport" – nurse; "providing resources to facilities" – admin staff
Shortage of medicine	4.3	
Environmental		
Poor infrastructure*	**5.7**	"facilities need to be renovated and adequately maintained" – nurse;
Clinic Size	3.6	"department of health must provide shelters or tents to have space to consult patients" – CHBC worker
Person		
Community health and education	1.4	"community must be educated around the importance of complying with healthcare and various health problems"
Task		
High Risk Work	1.4	"provide transport and protective clothing"

Note. The most reported high priority barriers are annotated with asterisks (*).

A **shortage of tools and equipment** was the second most reported barrier to the performance of the South African health system (table 6). This included general *medical equipment*, *cleaning materials*, *protective clothing,* and *transportation (for CHBC workers to visit community, and for management to visit various clinics).*

Referring to a shortage of *tools and equipment*, many participants reported on "*inadequate equipment",* while more specifically, a security officer reported on "*a lack of equipment to protect ourselves"*. Additionally, pharmacists and others frequently referred to "*a lack of medication stock"* as high priority barriers to the health system. One nurse commented that solving this issue requires "*provisional government to provide equipment and transport"* while other participants suggest "*repairing equipment"* and "*providing resources to facilities"* as stated by an admin staff member.

The third most reported barrier was **job security** (table 6)**.** Many participants refer to staff working on contract, and not having the security that they will have permanent work. This was reflected in a comment from a CHBC worker when they wrote "*signing of contracts make us lack doing our work because we don't know if it's going to be renewed or not"* while a nurse stated that "*the department does not care about the people who work for it, for example care givers [who have] worked for more than 20 years are still on contract"*. In response to this, participants proposed "*permanent employment from the department of health"*, where participants suggested that government needs to enable the "*permanent absorption"* of contract workers, as stated by a CHBC worker.

Participants reported on issues related to **Poor infrastructure** as high priority barriers (table 6) - these include issues around *inadequate, broken or unmaintained infrastructure*, as reported by nurses and maintenance staff that "*cracks in the walls*" and "*no patient toilets*" severely limits the functioning of facilities and ultimately the national health system. One pharmacist described issues around "*buildings not suitable for primary healthcare facilities (ours was an old school)*", and a management staff member commented that infrastructure is "*poorly located and inadequate"*. Barriers related to poor infrastructure were reported by many participants to be overcome by renovating, maintaining or extending facilities. A CHBC worker reflected on this by commenting "*if the department can supply us with a shelter or a tent so that we can have our space to consult"* while a nurse suggested "*extending facilities and structures to accommodate all services".* Moreover, one participant from admin staff group suggested that "*government needs to build enough space – for example, the waiting rooms are too small".*

Additional proposed solutions included **improving management and leadership** through training and discipline. **Building more clinics** to accommodate a shortage of facilities was also a suggestion while; enabling **citizens to take responsibility for their health**, by complying with health care, and by educating themselves and others was another. Participants also prioritised the need for **government to provide better service delivery**, by ordering equipment and services appropriately, or by supplying adequate water and electricity to facilities. Another proposed solution included **informing the government** of the problems, to enable effective communication and decision-making, while also stressing the importance of the **provision of adequate training** on the appropriate topics, at the appropriate times. Four participants reported "***no comment***" **or "*no idea*"** where they were uncertain as to how to overcome certain high priority barriers to national healthcare delivery.

4.2.2. Reported barriers to national healthcare delivery across workgroups

The reported barriers, per system component, were categorised according to workgroup in order to differentiate (across workgroups) between the perceptions around barriers to South African healthcare (figure 10). This is important for the relevant research as understanding what different stakeholders perceived as barriers to national healthcare delivery may give insights into a possible disconnect or misalignment between these levels. Any disconnect may contribute to the inability to improve on or address poor-quality related processes and outcomes. The categorisation of the barriers into the work system elements allows for comprehensive understanding and a presentable way of highlighting and discussing the systemic aspects.

Referring to figure 10, *across all workgroups*, the majority of reported barriers perceived to limit the South African health system were categorised as organisational, followed by tool and technology related barriers while maintenance staff reported no task-related barriers. The top three most reported barriers, for each workgroup shown shown in table 7 and discussed in detail in text:

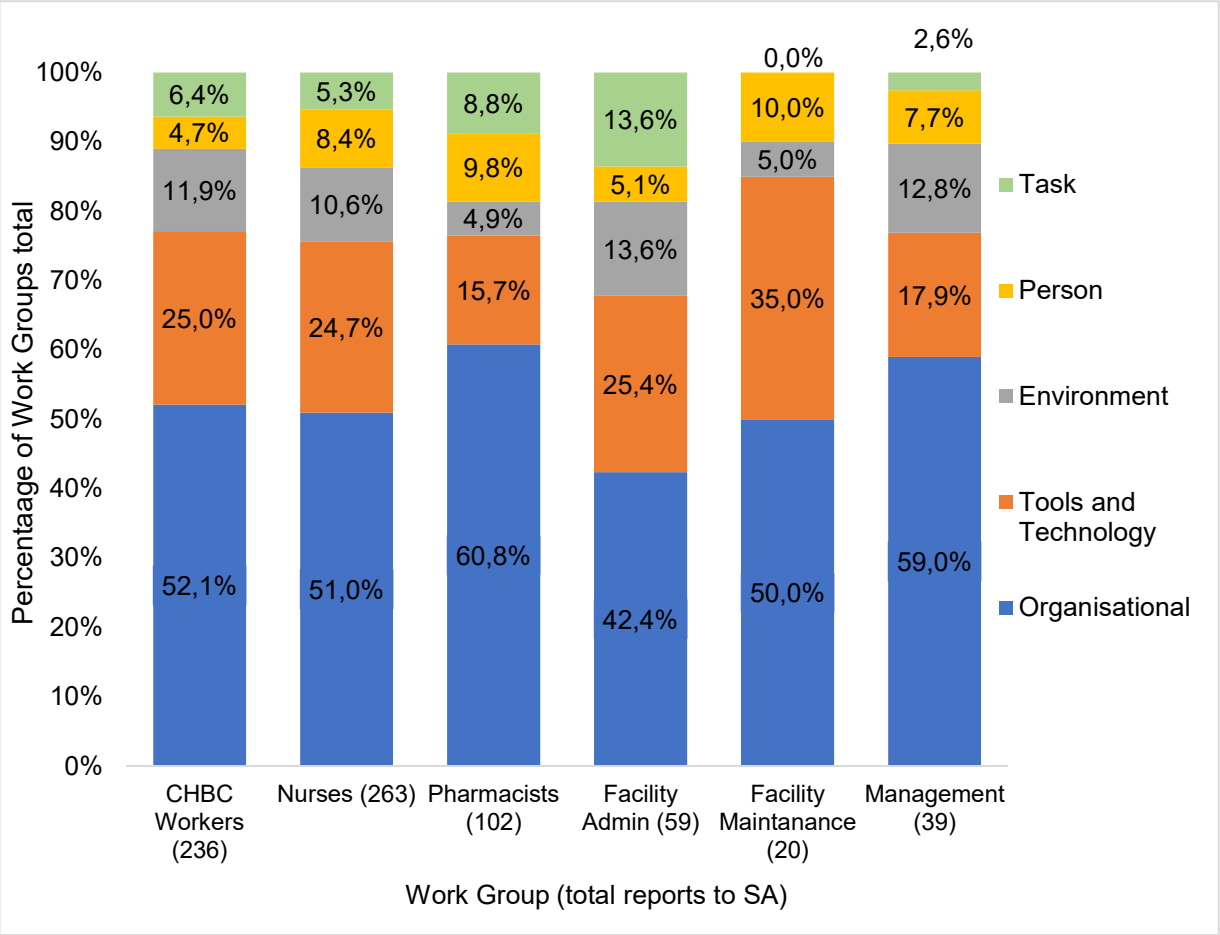


Figure 10. Each work groups' perceived barriers to South African healthcare delivery, categorised into work system elements

CHBC workers' most reported barriers to national healthcare

As mentioned above, the most reported barriers across all work groups, except for management staff, is the perception of *a **shortage of staff*** to limit the South African healthcare system. CHBC workers frequently reported on issues around a lack of healthcare practitioners, specifically doctors and nurses as well as *security guards* and *cleaning staff. F*or example, one CHBC worker added that having no *"security guard to safeguard belongings of the buildings after hours"* may affect healthcare provision in South Africa's healthcare system. ***Job security*** was the second most reported barrier from CHBC workers indicating that CHBC workers perceive a lack of job security for certain staff, as a major barrier to the performance of South African

healthcare system. One CHBC worker commented on "*not absorbing community health workers*", while another reported that *"for permanent posts, they employ external members and [do] not consider internal applicants"*. CHBC workers also frequently reported on a **lack of uniform** as a barrier to the South African health system, as described by one CHBC worker where "*uniform is something that can define / show your training [qualification]"*, and others who frequently reported on "*no uniform*". Another CHBC worker reported that "*every second or third year we receive uniform",* as a barrier to ensure effective high-quality care nationally (table 7).

Table 7. Top reported barriers to SA healthcare, per workgroup

Work Group (number of participants)	Most reported barriers	Percentage (%) of Work Group's total reports
CHBC workers (45)	Shortage of staff	18,2
	Poor Job Security	6,7
	Lack of Uniform	4,6
Nurses (40)	Shortage of staff	17,8
	Poor management and Leadership	9,1
	Facility size	4,5
Pharmacy (13)	Shortage of staff	12,7
	Lack of medicines	10,7
	Adherence to policy and guideline	9,8
Admin (11)	Shortage of staff	22
	Lack of training	6,7
	High workloads	6,7
Maintenance (6)	Shortage of staff	20
	Poor service delivery	10
	lack of tools and equipment	10
Management (5)	Inadequate infrastructure	12,8
	Lack of training	10,2
	Poor management and leadership	7,6

Nurses top reported barriers to national healthcare

Aside from the prevalent ***shortage of staff****,* nursing staff frequently reported issues around ***poor management and leadership*** to limit the SA health system (table 7). Nurses perceive that the management at higher levels are inadequate with very little interest in the challenges faced by nurses. For example, one nurse commented that there are "*poor responses to primary challenges by provincial offices"* and another commented that there is "*poor management from the top to bottom".* There are perceptions of corruption and poor budget management as barriers as well. One nurse reflected on this by reporting on "*corruption of healthcare management"* while another commented on "*inappropriate utilisation of funds".* A nurse reflected further on a lack of support from management by stating that "*ward counsellors do not bother about visiting the clinics"* limits the performance of the South African health system. Moreover, nurses frequently reported on the perception that **facilities are too small** to constantly achieve high-quality care delivery. "Limited space" was frequently reported by nurses, indicating that the size of the facilities is not conducive for effective healthcare delivery for example, one nurse reported on this by stating "*unconducive working environment (small clinic)",* and another indicated that "*there is often no equipment storage".*

Pharmacists top reported barriers to national healthcare

A *shortage of staff*, ***lack of medication*** and **a *lack of policy and guideline adherence*** were the top three most reported barriers to the South African health system, as perceived by pharmacy staff (table 7). *A lack of policy and guidelines* referred to the availability of, as well as the adherence and compliance to policies and guidelines. Barriers related to a lack of policy and guidelines were frequently reported by pharmacy staff, for example, one pharmacist reported on "*poor infection control measures",* while another reported that there are "*no policies and no consequences".* This is further evident from another comment, reported by a pharmacist referring to "*a lack of accountability, where punishment doesn't fit the crime*".

Admin staff top reported barriers to national healthcare

Furthermore, ***a lack of staff***, ***a lack of training***, specifically around how to use technology (such as computers), and ***high workloads***, related to a shortage of staff

were barriers frequently reported by admin staff to limit healthcare provision nationally. This is evident in a response captured by an admin staff member stating that "*doing two peoples work*", or in another comment where "*doing a job as a data capturer and also having to do administration for the facility*" adds to workloads, both of which were frequently reported by Admin staff (table 7).

Maintenance staff's top reported barriers to national healthcare

Maintenance staff frequently reported on a ***shortage of staff,*** a ***lack of tools and equipment***, specifically as reported by one facility caretaker as "*lack of protective clothing*" and "*cleaning materials"*; as well as ***poor service delivery*** as perceived barriers (table 7). Poor service delivery relates to supply and delivery of services responsible for enabling high-quality care, and include the procurement of goods and services, such as cleaning material as well as clean water. Maintenance staff frequently perceive a lack of these tools and equipment, as well as service delivery (availability of clean water and ordering of cleaning material) as barriers, which limit the South African health system. For example, as shown in a report from a maintenance staff member where "*outsourcing of government tenders without proper follow up"* leads to inappropriate service delivery and inadequate procurement of tools and equipment. This was captured in a comment from a facility caretaker who stated "*a lack of equipment"* while another reported "*a lack of uniform and protective gear"* as perceived to limit the South African health system.

Management's top reported barriers to national healthcare

As mentioned above, and unlike all other workgroups is the most reported barrier perceived by management staff, which related to ***inadequate infrastructure*** (table 7)*,* specifically inadequate and poorly maintained infrastructure where facilities are in poor condition and do not enable high-quality care. This is reflected in one management staff's report stating "*old facilities, not suitable for PHC [primary healthcare] facilities"* and in another report where management perceive poor standards and conditions of gravel roads, especially in rural areas as being challenging the assurance of high-quality care delivery in such contexts. Management also perceive *a* ***lack of training*** to limit South African healthcare as evident from one report indicating that "*the quality of new graduates is poor, due to a lack of training offered*". Another management staff member perceived that "*clashing of trainings"* to limit SA healthcare, by not affording

equal training opportunities to staff, which is further supported by another management staff's report commenting on "*short notification of trainings".* Lastly, management staff frequently reported on ***poor levels of management and leadership*** to limit the South African healthcare system. Management staff perceive poor levels of management, specifically from positions above themselves, to limit the performance of the South African health system. For example, one management staff member commented on "*inexperienced senior management and poor leadership"* while another commented on *"a lack of accountability in management"*.

These abovementioned barriers indicate the perceptions, at different workgroups, around what barriers limit the South African health system (at a **national** level), what are perceived as the highest priority and how these high priority barriers might be addressed. The following section (section 4.3) will outline the barriers perceived by these stakeholders to limit the performance of their own work (barriers to South African healthcare, at a **local** level).

4.3. Section 3 – Barriers reported to limit participants own work

Participants reported 791 barriers that they perceive to limit the performance of their own work. A word cloud showing the top 50 most frequent words referring to participants' reported barriers around their own work is shown in figure 11.

Similar to section 4.2 the word cloud indicates that participants most frequently referred to **"staff", "shortage", "patients" "lack",** and **"equipment"** in their responses to local barriers. This offers a preliminary thematic indication of the reported barriers among all stakeholders, which suggests that barriers relate to shortages of equipment and staff, as well as barriers related to patients.

The 791 reported barriers perceived by stakeholders to limit their own work performance, were thematically analysed and categorised according to elements of the work system model (Smith and Carayon, 1989; Carayon, 2009; table 3). Across all workgroups, 43.8% of reports were categorised as organisational; 19.9% as tool and technology related; 12.7% as environmental; 13.7% as person related; and 9.6% as task-related barriers. The topmost reported barriers, grouped by system component are shown red in table 8, and examples of which are described in text.

Figure 11. Word cloud showing top 50 frequent words related to perceived barriers to participants' own work.

Organisational barriers to local performance

The most reported organisational barriers, perceived to limit participants own work included a ***shortage of staff***, such as *healthcare practitioners*, *security personnel*, and *cleaning staff*; **poor levels of management and leadership**, which included issues such as *poor budget management* and a *lack of support*. Some participants perceive *budget mismanagement*, or "*inappropriate utilization of funds"* as described by a pharmacist, as a barrier to their own work, as it relates to how resources are procured, and how wages are paid. This former is supported by a comment from a pharmacist who reported "*inadequate drug budget allocations"* which results in medicine stock-outs, and the latter by many nurses who reported "*being underpaid"* as a high priority barrier to their work (table 9).

Poor levels of management and leadership also related to issues around a *lack of support* from management, as described in a comment from one participant where there is "*poor response to primary challenges by provincial offices",* and in a comment from a nurse stating that "*staff [are] not included in policy formulation".* Participants perceive such a lack of engagement and support from management as a barrier to their work – and this was further reflected in the perception of "*poor management from all from top to bottom"* - where management, *at all levels,* is inadequate or

inappropriate, as stated by a management staff member. Moreover, this was echoed in comments by many participants around the perception of "*corruption of political officials leading the Dept of health"* which is related to mismanagement of finances, and poor levels of support and management.

Table 8. Top reported barriers to own work, across all workgroups, per system component

System Component (% of overall reports)	Main barriers to Own Work (total reports: 791)	Percentage Coverage of system component total
Organisational (43.8%, n=347)	Lack of staff*	10,6% (n=83)
	Poor management and leadership*	6,2% (n=49)
	High numbers of patients*	5,4% (n=42)
	Lack of training	3,7% (n=29)
	Job Security	2,7% (n=21)
Tool & technology (19.9%, n=158)	Lack of 'tools and equipment'*	7,0% (n=55)
	Lack of medication	3,3% (n=26)
	Broken or Unserviced equipment	2,3% (n=18)
Environment (12.7%, n=102)	Poor infrastructure	3,7% (n=29)
	Poor hygiene and sanitation	1,8% (n=14)
	Facility too small	1,8% (n=14)
	Security	1,5% (n=11)
Person (13.7%, n=108)	Poor patient attitudes*	5,1% (n=40)
	Poor adherence to guidelines	3,9% (n=30)
	People are different	1,9% (n=15)
	Low levels of community health and education	1,8% (n=14)
Task (9.6%, n=76)	High Workloads*	4,3% (n=34)
	Difficulty doing task	2,7% (n=21)
	High Risk Work	2,7% (n=21)

Note. The most reported barriers are annotated with asterisks (*).

High numbers of patients was also a frequently reported barrier perceived by participants (table 8). For example, one participant commented on "*unlimited numbers of patients per day"*. At the same time, another reflected on "*the clinics serving a large number of people as new informal settlements are being built or expanded". "Overpopulation"* as stated by one CHBC worker, together with a report from a nurse

where "*the facility isn't big enough for the community"* indicates the link between high numbers of patients, **high workloads**, which was a frequently reported task-related barrier. This was accompanied by comments related to a **shortage of facilities**, which was also frequently reported as an organisational barriers (table 8).

Tool and technology barriers to local performance

A lack of tools and equipment was a frequent tool and technology related barrier reported across all workgroups, with many participants referring to "*medical equipment"*, as reflected in a nurse's report, as well as general assets (such as *stationery, uniform* and *computers*) and **medication** (table 8). Supporting this was a CHBC worker's comment where "*we don't have a copy machine to make the consent forms…. We have to do HIV testing without consent"*, as well as a comment added by a nurse where there is a "*shortage of basic materials to run a clinic. For example, toilet paper and paper towels".* Moreover, security personnel of a facility are valuable stakeholders in that they protect and secure the staff, clients, and infrastructure. One comment added by a security personnel who was also responsible for maintenance was that they "*don't have firearm [protection], when someone from outside comes in with guns, we run for our lives leaving the nurses behind".*

Environmental barriers to local performance

The topmost reported environmental barrier included **poor infrastructure** where *infrastructure, facility security*, *poor levels of hygiene and sanitation*, and *facility size* were frequent themes perceived and identified to limit local stakeholder's own work (table 8). One nurse reflected on the inadequate infrastructure by commenting that "*the clinic is too old"* while an admin staff added "*big cracks in patient toilets that can cause an accident"* while another nurse added that "*the standard of the facility is not in good condition"*. One participant summarises these issues with the comment of *"our premises are not in a good condition, the walls are falling apart (cracked), which is very dangerous to staff and patients, and the facility is too small to accommodate patients".* Moreover, **low hygiene and sanitation** is perceived by few participants to limit work (table 8); for example, a nurses' comment referred to "*the cleanliness of facilities"* being inadequate. One participant reported that "*dumping sites around the clinic, and sometimes the septic tank overflows"* are barriers to their work, well-being and safety. Poor hygiene and sanitation is further supported by few participants who reported on

"*no cleaner to clean the facility"* which results in unconducive working environments, or increases in workloads as one nurse describes by *"having to clean before the facility opens due to staff shortages".* Many participants perceived **inadequate space** as well. To this end, a nurse commented that "*there are not enough consulting rooms"* and admin staff reported on "*the filing area (records room) too small".*

Person-related barriers to local performance

The most frequent person related barriers perceived to limit participants' work, included ***poor patient* attitudes**, where patients do not respect staff, conduct poor behaviours, and do not follow guidelines. For example, a nurse commented on "*rude patients swearing at us"* and a pharmacist added that "*alcohol and drug uses increases TB and HIV infections, making our work harder".* Another frequently reported barrier to the performance of participants own work, is the perception that patients do not follow procedures and guidelines (table 8). This is evident in a response from a nurse stating "*clients don't want to go to their nearest clinic"* and "*people don't want to wait at the clinic, they just want to be served and go".* Many nurses report that patients give "*the wrong addresses when tracing"* as well as "*miss[ing] appointments"*. One nurse in particular described this theme in a comment stating that *"some clients do not honour their appointments and that leads to overcrowding in the facility and that obstructs me from performing my duties on time"*.

Task-related barriers to local performance

High workloads were found to be the most reported task-related barrier to the performance of participants own work (table 8). One nurse describes this in a comment on "*overworked syndrome"* while others frequently refer to "*staff burnout"* and "*overloading of work".* High workloads strongly relate to the number of patients – which is reflected in one participant's response stating "*you have to work faster to get clients helped";* as well as the amount of staff available as reported by a nurse who stated that "*doing two people's jobs"* limits their performance.

Moreover, a data capturer stated that "*my job as data capturer and also having to do administration for the facility"* and a pharmacist stated that "*time is wasted doing other people's work"*. **Difficulty doing tasks** was a frequent theme reported by participants, for example a CHBC worker commented that "*we walk up and down the community in hot or cold weather with nothing to protect us"* and a pharmacist reported that "*weekly*

reporting on cell phones is slow and time consuming" when referring to the task demands. Participants also perceive **high-risk work** to be a barrier to their own work (table 8), as reflected on in a CHBC workers comment: "*we walk up and down [the location] and can be victims"*, as well as in another comment from a CHBC worker where "*they deal with people who have different diseases, without any protection".* Many CHBC workers perceive working "*in the community"* to be unsafe and this risk limits them from being able to appropriately perform their jobs.

4.3.1. Local barriers perceived as high priority and proposed solutions

Participants were asked to report on the top barrier that they perceive as high priority to limit their own work. Participants reported 79 barriers to the performance of their own work, which they perceive as high priority (HP). These were thematically analysed, categorised according to system elements, and are presented in table 9 with the most frequent of the barriers highlighted in bold red. The most frequent barriers perceived as high priority to limit the performance, across all workgroups, included **a lack of staff** (31.6%)**, poor infrastructure** (25.3%)**, facility size** (11.3%), **a lack of tools and equipment** (10.1%), **high workloads** (7.5%) and **job security** (7.5%). Table 9 reflects the reported high priority barriers, as well as examples of the proposed solutions.

The most frequently reported barrier, perceived as high priority, included **a lack of staff** where not having enough staff members adds to overall workloads. This was the most frequently reported barrier, perceived as high priority to limit the performance of participants own work. Participants proposed that "*employing more staff"*, including "*security staff"* and doctors (table 9).

Poor infrastructure was also frequently reported as a high priority barrier at a local level (table 9), with issues related to *inadequate space* and *broken or unmaintained* infrastructure. One participant commented as a high priority barrier that "*we need a storage room"* while another added that "*our facility is too small, there are not enough consulting rooms".* Participants' proposed solution to overcoming this barrier included efforts of involving government bodies to appropriately maintain, renovate or rebuild facilities to accommodate the services required. One nurse added that "*by making waiting area user friendly to maintain confidentiality"* while another proposed to *"liaise with the department of health and other NGO's to ensure infrastructure in the facility is in good quality form".*

Table 9. High priority barriers perceived to limit the performance of own work and proposed solutions

HIGH PRIORITY BARRIERS (79 TOTAL REPORTS)	PERCENTAGE OF TOTAL REPORTED HIGH PRIORITY BARRIERS	PROPOSED SOLUTIONS
Organisational		
Lack of staff *	**31.6**	"government must employ more staff"
Job security *	**7.5**	"I want to be employed and have government benefits
High numbers of patients	**6.3**	
Adherence of protocols and guidelines	**3.7**	
Lack of training	**3.7**	"training must be provided"; "government must make sure training must be in the right language"
Poor management and leadership	**3.7**	
Service Delivery	**3.7**	
Underpaid	**3.7**	
Tool and Technology		
Lack of tools and equipment*	**10.1**	"if the government can supply us with more equipment."
Broken or unserviced equipment	**2.5**	"every 5 years computers must also be changed in between the years, service of computers must be done"
Medication	**2.5**	
'Resources'	**2.5**	
Environment		
Poor infrastructure *	**25.3**	"We need more storage room"; "make waiting areas more user friendly"
Facility size *	**11.3**	
Task		
Workloads *	**7.5**	"reduce unnecessary paperwork"
Security	**3.7**	
Person		
Uncooperative patients	**5**	"educate patients on honouring the booking system"

Note. The most reported high priority barriers are annotated with asterisk (*).

A lack of tools and equipment, such *medical equipment, uniforms,* and *medication* were frequent high priority barriers reported to limit the performance of participants own work (table 9). Many participants referred to *a shortage of 'resources',* as described by a nurse who stated that "*there is a shortage of resources (finance, human, and material)"*. *Uniform* is an important aspect of healthcare practitioners as it offers protection, as well as enables empowerment of staff. A shortage of uniform, therefore, limits the performance of work, as described by a CHBC worker who commented on a lack of "*uniform as I have to work in my own clothes and footwear"* as high priority, while a security officer stated that as a high priority barrier, they don't have "*equipment, because I don't know how to protect myself".*

Participants' proposed that it order to overcome these barriers, they need to *be supplied with more equipment and technology*. For example a CHBC worker reported "*if management can come to an agreement to meet my needs of uniform"* as a solution, while the security officer reported that "*if the company can provide us with at least equipment I think at least it can be better".* One participant responded to a lack of transport with "*they [*government / management – researchers interpretation*] must provide a car for the facility".* Referring to **unmaintained or unserviced equipment,** such as "*computers", "photo copier"* and certain medical equipment, some admin staff proposed that "*every 5 years computers must be changed also in between the years, service of computers must be done*".

Participants frequently perceived **job security** as a high priority barrier limiting their work (table 9), specifically referring to as described by a nurse as "*permanent employment",* and further by a CHBC worker as "*permanent absorption".* A nurse reported that "*we or I want to be employed and have government benefits".* Beyond *employing more staff*, participants reported that absorption of contract workers into permanent posts would enable job satisfaction and reduce fears of job security where they are not certain about permanent work. This is shared by many CHBC workers who stated "*absorption of community health workers into the department of health"* and a nurse who reported on "*creating permanent jobs, not contracts, as we are running out of time age wise".*

High workloads were perceived by participants as a high priority barrier (table 9), where a CHBC worker reported on "*burnout syndrome",* and a nurse commented on

"*focusing on one client at a time is challenging".* High workloads is also described by a pharmacists as "*working beyond your scope"* and by a nurse who reported on having "*unreal expectations from managers and users".* Participants responded to this barrier with the common reported solution of "*government must hire more staff"* to reduce the workload pressures of current healthcare practitioners.

Further solutions proposed by participants to overcome less frequent high priority barrier (table 9) included **better involvement of management and leadership** (for example, as reported by one participant who stated that "*for managers to stop planning for employees without their input and to communicate collectively with employees and consumers").* There was also the suggestion **to provide adequate training** through *appropriate training courses (specifically about how to use computers)* and as stated by a nurse, "*ensuring that there is adequate training and that at least one personnel attends every training there is".* ***'Systems' to be improved,*** for example, "*educating people on the booking system and the importance of following it"*; a pharmacist commented that "*the government should allow us to order more medication form the medical depot"* while an admin staff proposed to "*reduce or eliminate unnecessary reports and paper work"*. **Service delivery** can be improved by "*asking patients to rate our system and complain if things are not in place, making it easier for them to lodge complaints".* One participant stated that "*government should make sure deliveries arrive on time",* indicating plenty of dependency from stakeholders on the local (and national) government to address the barriers.

4.3.2. Perceived barriers to local performance across workgroups

The coverage of reported barriers, per system component, was grouped by workgroup in order to differentiate (at a work-systems level) between the perceptions around barriers to the local health system across different groups of stakeholders (figure 12).

As seen in figure 12, the reported barriers perceived to limit the local health system varied across workgroups, with the majority of CHBC workers', nurses', pharmacists' and managements' barriers categorised as organisational (as mentioned above). Most of the barriers perceived by facility admin were categorised as *environmental,* which included issues such as *inadequate space*, and *poor infrastructure* (table 10). The majority of reported barriers perceived to limit facility maintenance staff from

performing their work were related to tools and technology, specifically *a lack of tools and equipment* such as protective gear, uniform, and cleaning materials.

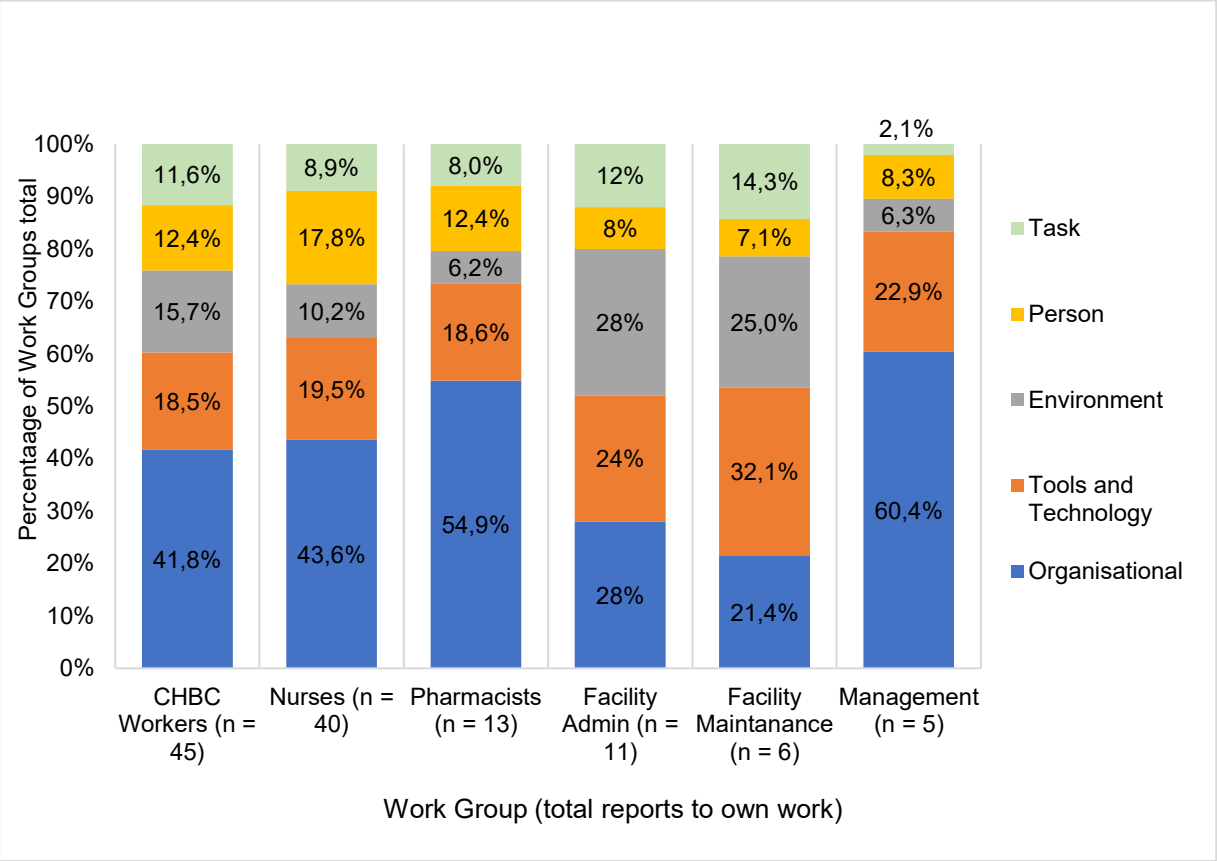


Figure 12. Each workgroups' perceived barriers to their own work, categorised according to work system elements

Responding to study objectives, the specific barriers most frequently reported for each workgroup (i.e. what each workgroup perceive to limit their work) is outlined and described in table 10.

CHBC workers reported barriers to local performance

CHBC workers' most frequently perceived barrier to the performance of their work included **a shortage of staff** (table 10). CHBC workers perceive a shortage of staff to limit their work by increasing *workloads* and adding overall pressure onto the health system capacity: "*we need more nurses", "cleaners are needed,* and "*healthcare workers ratio to patients"* were frequent issues reported by CHBC workers alike. The majority of reports related to **Job security** were reported by CHBC worker's where one

CHBC worker commented on having "*more working hours without being permanent"* while another added on having "*no benefits and signing contracts for more than 9 years".* CHBC workers perceive a lack of permanent job opportunities offered by the Department of Health, to limit their performance, as described in a comment from another CHBC worker: "*the department of health must please employ us, the community health workers as soon as possible. It has been many years now. People come here and we show them their duties and after 3 months they become permanently employed. This is not right, we are stressed and dying because of depression. We have families to look after, please help".*

Table 10. Top reported barriers to local work, per work group

Work Group (number of participants)	Most reported barriers	Percentage (%) of Work Group's total reports
CHBC (45)	Shortage of staff	10,0
	Job Security	6,4
	High risk work	6,4
Nurses (40)	Shortage of staff	12,5
	lack of tools and equipment	9,6
	High numbers of patients	7,6
Pharmacy (13)	Poor management and leadership	9,7
	Poor staff behaviours	7,1
	lack of medication	7,1
Facility Admin (11)	Inadequate space	14,0
	Broken or Unserviced equipment	8,0
	Lack of tools and equipment	8,0
Maintenance (26)	Lack of uniform	14,3
	poor infrastructure	14,3
	Hygiene and sanitation	10,7
Management (5)	Poor management and leadership	14,6
	Lack of transportation	10,4
	Poor service delivery	8,3

Furthermore, CHBC workers frequently reported that they were had to perform **high risk work** as a limitation to the performance of their work (table 10). For example, many community health workers commented that "*we are dealing with patients who have many infectious diseases"* and "*doing door to door visits can be dangerous and we can become victims".* Related to *job security* and *high-risk work,* were two similar reports form CHBC workers stating that "*we are at high risk of contracting diseases like TB and we don't have medical aid".*

Nurses reported barriers to local performance

Similarly, to CHBC workers, nurses frequently reported on a **shortage of staff** to limit their work, with examples including "*cleaning staff",* "*nurse to patient ratio not balanced"*, and a "*shortage of effective and efficient staff".* One nurse reported on a shortage of security personnel as a barrier in the sense that "*in [the] clinic, we don't have security and sometimes clients come in the facility under the influence of alcohol and they use verbal abuse and there is no security to take them out, we are not safe".*

Additional barriers frequently perceived by nurses included **a shortage of tools and equipment** such as "*resources*", "*medical equipment", "medication"* and *"stationary"* as reported by multiple nurses. One nurse reported on "*no usable equipment"* which is echoed in another report stating a *"lack of working instruments".* One nurse commented on a lack of equipment supplied to security officers "*not having weapons to protect us"* while another reported on a "*lack of resources where one has to sometimes buy own paper towels / toilet paper".* Some nurses perceive there to be "*not enough access to technologies"* such as computers, printers, and up to date medical equipment as opposed to other facilities – which was reflected in a nurse's comment of "*in other facilities, there is equipment".*

High numbers of patients was a frequent perception from nurses (table 10) who reported on "*overpopulation"* and "*growing communities"* to affect workloads and negatively affect job satisfaction. This was supported in a comment from one nurse who stated "*high numbers of patients as compared to nurses"* and another who added "*large catchment areas"* of facilities results in "*overflowing of facilities".* Nurses perceive these barriers frequently to limit their performance, and ultimately their local health system by adding to overall workloads and pressurising the facilities functional capacity.

Pharmacy staff's reported barriers to local performance

Pharmacy staff typically perceive **poor management and leadership** (table 10), which they describe with issues such as "*corruption*" and "*no recognition for work done"* to affect their performance. One pharmacy staff member commented "*our manager is powerless to punish non/low performing staff in the facility"* while another added that the "*manager of the facility is unable to handle it, things don't get done"*. The majority of pharmacy staff's perceptions were around poor levels of management and leadership, however pharmacy staff also frequently reported on **poor staff behaviours**. Pharmacy staff perceive the behaviours of fellow staff members to be inappropriate, ultimately limiting the ability to perform their own work, for example one pharmacist commented that "*staff foes [do] not put in hard work as they should",* and another added "*a lack of responsibilities, laziness".*

Another pharmacy staff member reported that "*staff show a lack of compassion towards patients",* while another assigned blame directly to the psychiatric sister and doctor where *"no accountability, dreadful care*" is offered. Pharmacy staff also frequently reported on the perception of **a lack of medication** due to *financial [mis]management*, or issues when ordering from the depot. A lack of medication, or "*medicine stockout"* as described by the pharmacists, severely limits their performance, as medication dispensing is a primary role of pharmacists, as well as to ensure high-quality care.

Admin staff's reported barriers to local performance

Inadequate space was a frequently reported on perception from admin staff where a lack of "*storage", "consulting rooms"* and "*waiting areas"* limits the ability to perform work as facilities become "*overcrowded"* as described by an admin staff, as well as a lack of "*storage space*" for archiving and records. Admin staff also frequently reported on **broken and unserviced equipment** as a barrier to their own work (table 10), specifically related to computers, printers and fax machines. One admin staff reported on the "*fax machine not working since 2018"* while another commented on "*computers that are old and failing".* Not having access to working technology, such as computers, severely limits administration tasks of the facility and ultimately the performance of the facility.

Moreover, barriers related to **a lack of tools and equipment** were frequently reported by admin staff, specifically referring to photo copiers, fax machines, cleaning materials and stationary. One participant commented on there being "*a delay when placing orders for the stationary and cleaning material"* while another added that there are "*no lockable cabinets for keeping cleaning materials in".* Not having access to certain equipment limits performance, for example as reflected on by an admin staff where "*not being able to print for 6 months already".*

Maintenance staff's reported barriers to local performance

As mentioned above, the majority of maintenance staff's barriers included a **lack of uniform**, specifically "*protective clothing*". Maintenance staff perceive a lack of uniform to be a frequent barrier as described by one cleaner as "*sometimes you don't necessarily have protective clothing to perform your duties"* while another added "*the protective clothing [I don't have] when using [dangerous] mechanical equipment".* One maintenance staff member reported that "*we only receive uniform once".* Maintenance staff frequently perceived **poor infrastructure** to limit the performance of their jobs (table 10), with issues such as the being "*many cracks in the facility". "So many big trees around the facility"* was reported by a maintenance staff member to challenge their work by making "*the tank water brownish, gutters are dirty because trees are not cut".* Maintenance staff also perceive **poor hygiene and sanitation** issues frequently to limit their jobs for example, as reported by a maintenance staff member that "*local municipality stops water without notice and toilets can't be flushed"* as well as the tall overgrown trees result in lots of leaves and dirty tank water.

Management staffs perceived barriers to local performance

Lastly, participants from management level identified **poor management and leadership** as the biggest barrier to their work (table 10). Management staff perceive management at their level, as well as management (above them at higher levels to be inadequate, ultimately limiting their performance. This was reflected in a comment from on manager who perceives "*poor leadership"* and another who commented on "*poor and erratic planning".* Management staff also perceive issues around budget management to limit their performance, as evident in a comment from one manager who stated that there is "*insufficient budget".* **A lack of transportation** was also a frequent barrier perceived by management to limit their work, as stated by a

management staff member where "[*we] can't visit facilities because there is no transport*" and *"meetings are centralised and difficult to get to*". **Poor service delivery** was a frequently reported barrier from management staff and this is described in a comment from a participant who stated "*medication unavailability from suppliers"* limits the service delivery of healthcare, while another staff member added that "*long process of procurement of stationery, medication etc"* limits the ability to appropriately do their work.

Chapter 5

Discussion

The current study aimed to explore the perceived systemic barriers perceived by different Sarah Baartman District stakeholders, to the provision of healthcare at a national level and performance locally. The survey results demonstrate several important findings:

Firstly, stakeholders across all workgroups report similar barriers to national healthcare delivery in South Africa (SA). These barriers were categorised according to work system components (Smith and Carayon, 1989; Carayon, 2009) and are shown in figure 13. There were also many common local barriers reported across the stakeholders, which are shown in figure 13 with asterisks (*). Across all workgroups the top reported barriers by stakeholders to limit their own work and healthcare provision in SA, included: poor organisational management and leadership, a lack of human, financial and material resources, a lack of training, and weak or failing infrastructure, amongst issues of job insecurity, high workloads, patient variability, and the perception of low levels of community health and education.

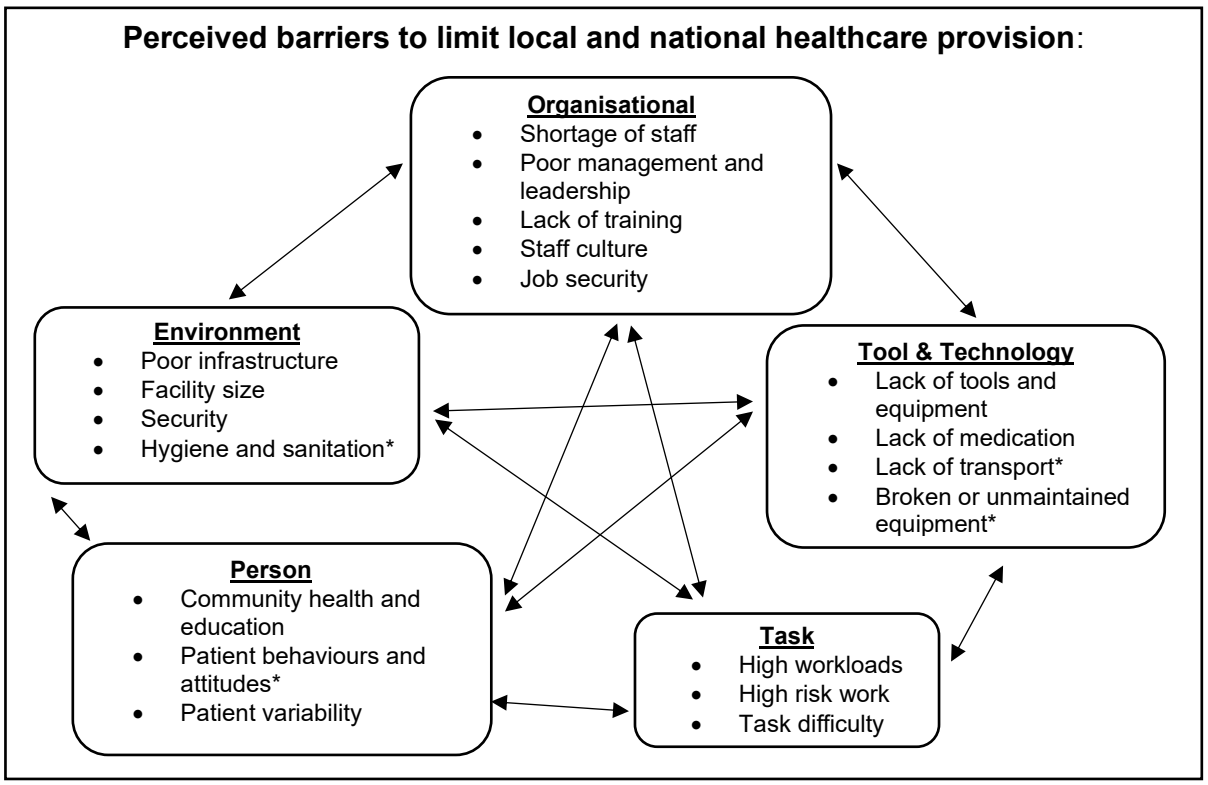


Figure 13. Challenges perceived to limit national and local healthcare from the perspective of stakeholders within the Sarah Baartman District, integrated into the work systems model (Smith & Carayon, 1989).

Secondly, although there were common challenges reported across all workgroups, the findings highlight that the way in which these barriers affect performance vary across workgroups. For example, a lack of equipment was reported by all workgroups, however, CHBC workers reported on specific issues related to a lack of uniform and transport, nurses and pharmacists reported on a lack of medicine and unmaintained equipment while maintenance staff reported on a lack of PPE and cleaning equipment. Understanding these different perspectives is important for facilitating risk management in complex systems, as described by Rasmussen's Risk Management Framework (RMF) (1997). It is important to consider the context-specific barriers faced by different workgroups to facilitate context-specific, user-centered initiatives aimed at addressing them.

Thirdly, the findings highlight that in the local context there may be a lack of integration between staff at the sharp-end and those at the blunt-end, which, if left unattended, may continue to make the provision of care challenging. This assertion stems from reports by sharp-end participants who highlighted that they are not included in policy formation. Participation of sharp-end stakeholders in policy design or implementation is essential for sociotechnical systems to establish sustainable improvements (Haines et al., 2002; Dul et al., 2012; Wilson, 2014; Van Eerd et al., 2016). This is in line with Rasmussen's assertion that risk management needs to be vertically integrated across different levels of stakeholders. Poor integration or communication across these levels has implications for all stakeholders involved in health system care processes.

The following discussion will therefore discuss these key findings according to the work system components (Carayon, 2009) by describing how these systemic barriers affect different workgroups and how stakeholders propose these may be overcome. The systemic nature of the reported barriers will then be consolidated, thereafter the findings are discussed in the light of the COVID-19 pandemic that was surging at the time this thesis was completed. Various study limitations, considerations and recommendations for local stakeholders are then highlighted.

5.1. Key findings and implications

5.1.1. Organisational barriers

Shortage of staff

In the current study the most prevalent organisational barrier, perceived across all workgroups for both national and local performance, was a shortage of staff (table 11). Participants from all workgroups commonly reported that a lack of staff results in shifting of roles and increased workloads. For example, where there is no cleaning staff, available staff are required to go to work earlier to ensure that the facility is cleaned before patients arrive. Additionally, nurses report that because of staff shortages, the care they provide is based on quantity rather than quality where they trade-off the quality of care for the number of patients needed to be seen.

Table 11. Organisational barriers to both SA and local healthcare delivery

System component	Perceived barriers that limit healthcare provision	Definition
Organisational	Shortage of staff	Including healthcare practioners (nurses, doctors, and pharmacists), managers, and support staff (cleaning, admin and security staff)
	Lack of training	Training opportunities limited or inappropriate (in different languages or on the wrong topics)
	Poor management and leadership	Lack of support or monitoring, poor communication and attitudes, corruption, poor budget management
	Job security	The lack of security of work due to contract work where future work is not guaranteed
	Staff culture	Staff attitudes, behaviours and compliance to protocol and policy

Staff shortages have been associated with high workloads, shifting of roles, increased physical and cognitive stress, fatigue, burnout and dissatisfaction (Greenglass et al., 203; Carayon, 2008; Neill, 2011; O'Connor et al., 2012) all of which were reported by participants in the Sarah Baartman District. These consequences have been associated with increased errors in healthcare as staff who experience stress or burnout may not be able to perform efficiently and effectively because their physical

and cognitive resources may be reduced (Greenglass et al, 2003; Landrigan et al., 2004; Olds and Clarke, 2010; Rogers et al., 2014). Furthermore, staff dissatisfaction caused from shifting of roles and increased workloads is an important component that can impact patient safety, productivity, performance, quality of care, retention and turnover, and overall commitment to the organisation and profession (Buerhaus et al., 2005).

A shortage of healthcare staff is a problem faced by health systems globally (Veld and Van De Voorde, 2014; Barker et al., 2017; WHO, 2018; Hignett et al., 2018). Moreover, Sub-Saharan Africa's health personnel population ratios have been reported to be the lowest in the world (Liese and Dussault, 2004) and in the context of SA, staff shortages have been reported in both private and public sectors with estimates of roughly 20% of vacant nursing positions country-wide (Coovadia et al., 2009).

To overcome this barrier, participants from the Sarah Baartman District proposed that "government" must advertise posts about vacancies and ensure that these advertisements are accessible to the unemployed / public. Additionally, participants propose that staff be allocated to facilities according to clinic disease profile (the demands of the facility) rather than head count (amount of patients). While at a local level participants reported a lack of staff in all categories, participants specifically proposed as a solution to this *high priority* challenge was to "hire more security personnel" indicating a *prioritized* demand for security staff at the local level. This highlights how a lack of staff may contribute to how stakeholders perceive the safety and security of their facilities.

Furthermore, a shortage of staff in higher management levels of the system could have widespread implications on the stakeholders in the Sarah Baartman system and more broadly. For example, according to the Department of Health (DoH) annual health report (DoH, 2017) and during the period of data collection (October – November 2019), the position of the Deputy Director General (DDG), who is responsible for hospital and tertiary health services, as well as human resource development (i.e. training) was vacant. Although it is currently unclear as to how the Department of Health had managed this vacancy, it could be argued that the objectives and goals of the DDG, that in part being to develop human resources through providing adequate training, may not have been appropriately met. This is supported by the reported lack

of training perceived as barriers by various workgroups, however further insights from higher levels are needed for a more holistic understanding.

Lack of training

Stakeholders from the sharp-end (both clinical and non-clinical workgroups) within the Sarah Baartman District perceive that there are not enough training opportunities offered to them (table 11). Additionally they stated that when training is offered, it is either inappropriate, irrelevant, or as reported by nurses, conducted in different languages (isiXhosa), which affects the ability of English-only speaking staff to understand and benefit from the training. The language in which training is offered is important considering that SA has 11 official languages. There needs to be a 'standard' language used for communication in order to ensure that training goals are met. With so many languages, it is difficult to offer training and development programs that meet the needs of all cultures. In the Eastern Cape, isiXhosa is the primary African language spoken. The assumption that all staff can communicate in isiXhosa results in training opportunities and workshops to be given in the 'common' language, which immediately limits all non-isiXhosa speaking staff in benefiting from training. The inability for stakeholders to receive the necessary training may limit individual staff's abilities to maintain and improve standards of medical practice, skills, attitudes, behaviours (Hughes, 1990; Soninno, 2016), and ultimately high-quality outcomes. Furthermore, although management stakeholders in this study did not report on a lack of training as a barrier to their own roles, they did highlight it as a barrier to the provision of care nationally. This suggests that management staff are aware of the poor or inadequate training reported by sharp-end staff.

Research suggests that a lack of knowledge and skills of sharp-end staff and managers, which is evidently perceived by stakeholders in the current findings, is a significant barrier to improving or achieving quality in healthcare (Devitt and Murphy, 2004; Audet et al., 2005; Neale, Vincent and Darzi, 2007; Dixon-Woods, 2019; WHO, 2010; Hignett et al., 2018). Such has been the case elsewhere in SA, where home-based care workers have reported on a lack of formal training as a barrier to their work (Etoori et al., 2010).

Moreover, the current findings indicate that a lack of training reported by sharp-end staff pertains to both clinical and more basic, non-clinical skills, such as computer

literacy. For example, stakeholders from the Sarah Baartman District feel that the most basic skills required to provide high quality healthcare in South Africa are not developed as they should and this limits the ability to adapt to or be prepared for unexpected situations (such as printers malfunctioning), or around the use of basic equipment and technology, such as computers. The inability for nurses or admin staff to use computers due to a lack of training may severely limit processes as they have to rely on other staff members to do the task, or they have to process booking and patient files on paper-based records as opposed to digital records. This in turn, may contribute to slower processes and increase the chance for error and frustration and makes reporting to district, provincial or national levels challenging. One participant informally stated to the researcher upon departure from a facility that they had been supplied computers to facilitate patient consultations and patient booking, however had not received any training around how to use basic word and spreadsheet processing software. They verbally stated that consequently, they rely on another staff member to do certain computer-based tasks, which ultimately jeopardises patient confidentiality and increases frustration and workloads among staff involved.

Management and Leadership

In addition to the consequences of both staff shortages and lack of training, stakeholders from all workgroups in the Sarah Baartman District, perceive that poor management and leadership limits national healthcare delivery, as well as their own performance. Common reports across all workgroups included no support, mentoring, empathy, communication from management, along with poor and at times, corrupt leadership (table 11).

There appears to be, from the responses obtained in this study, evidence of how nepotism and corruption are real concerns for sharp-end stakeholders in the Sarah Baartman district health system. Reports from sharp-end staff highlight that “management just don’t care” or “nothing gets done”, and issues related to “corruption” and “nepotism” within management, suggests that stakeholders perceive barriers of weak and poor management and leadership within SA healthcare. Participants from the sharp-end, typically nurses and pharmacy staff reported that there is no accountability from management and that they do not provide the necessary support. More specifically, poor budget allocations, the awarding of “cheap” tenders for

inadequate services and unjust discipline towards employees were highlighted by sharp-end stakeholders.

Management staff also reported a lack of management support or mentorship from above levels of management, suggesting possible shortfalls in the management and leadership capacity in the higher levels of the provincial and national health system. The perception of "*poor management from all from top to bottom"* where management, *at all levels,* is inadequate or inappropriate, as stated by a management staff member echoes similar findings from SA, which suggest that government faces limit institutional and leadership capacity as a barrier to performance (Managa, 2014).

Strong and effective management and leadership at all levels is vital for a healthcare organisations to provide support, enable communication, ensure that targets are met, and ultimately help to shape the values and behaviours adopted by stakeholders (Bass and Avolio, 1994; Helmreich and Merritt, 1998; Cohen et al., 2003; McFadden et al., 2009; Buckner et al., 2014; Ellinas, Allan, Johansson, 2017; Cheng et al., 2018). Furthermore, leadership characterised by nepotism, centralised decision making, who do not value and appreciate the inputs and feedback of all relevant stakeholders, and who do not actively engage in the development and improvement of the organisation typically promote disjointed and untrustworthy configurations of work systems. This can ultimately result in poor system interactions, processes, and outcomes (Bass and Avolio, 1994; Sarros, Cooper, Santora, 2008; McFadden et al., 2009; Carayon and Wood, 2009; Buckner et al., 2014; Ellinas, Allan, Johansson, 2017). In the current context, a lack of adequate support and weak levels of management or leadership,(table 11), form influential leverage points which shape culture, compliance, motivation, support, as well as facilitate financing, accountability and communication of staff, and therefore may contribute to decreased performance and poor quality outcomes at all levels.

Moreover, the aforementioned findings pertaining to a lack of appropriate financial management and leadership capacity align with findings from Managa (2014), who further reported that key obstacles in the performance at local and government levels in SA are problems with higher levels of *corruption* and *financial mismanagement*. A lack of accountability coupled with corruption and misconduct amongst DoH officials (Siddle, 2011) has also resulted in government failing to fulfil its mandate to ensure the

delivery of high-quality care. This is echoed by the DoH annual 18/19 report, which showed the increased financial pressure partly caused by R94.3 million (~$5.5 million USD) of irregular expenditure, which was noted as a result of procurement processes not being appropriately followed (Department of Health, p.9, 2019).

To address these barriers, participants propose that at a national level, capacity building for senior management is needed to enable barriers and constraints to be addressed. Sharp-end stakeholders propose that at the local level, “the department” must visit facilities so that problems can be voiced and heard, and so that support and mentoring can be provided. Stakeholders from across all workgroups highlight that proper budget management is needed for infrastructure and maintenance, resource procurement, as well as appropriate grading and salary increases. Participants further propose that management must avoid awarding tenders to companies who manufacture “cheap” medication or equipment.

Moreover, stakeholders who perceived financial mismanagement as *high priority* barriers to national healthcare propose that more funds need to be allocated to the DoH, suggesting further that top levels of leadership should ensure the appropriate financial distribution nationally. Such solutions would require invested efforts from senior management and governing bodies to enable leadership that is both accountable and transparent, aimed at improving overall organisational culture and overall system performance. Furthermore, an essential component for the assurance of high-quality care, and one that is strongly influenced by management and leadership, is that of communication (Sarros et al., 2008; McFadden et al., 2009; Barker et al., 2017), which stakeholders from the sharp-end in the Sarah Baartman District reported as a perceived barrier to national healthcare delivery, and their own work.

Poor Communication

The findings from the current study demonstrate that sharp-end stakeholders within the Sarah Baartman District perceive poor communication and centralised leadership to limit healthcare delivery nationally, as well as their own work. Centralised leadership refers to how decisions are made without consideration of their opinions around challenges to healthcare delivery and working conditions. For example, one nurse reported that better communication is needed between the people in “higher” areas

and the staff in the facility, and to involve staff before making important decisions. Moreover, participants at the sharp-end report that "*staff [are] not included in policy formulation"* and that *"managers [need] to stop planning for employees without their input and to communicate collectively with employees and consumers".*

The current findings suggest that the poor communication and a lack of integration between district management and sharp-end stakeholders may be partly due to constraints faced by management, such as a lack of transport, where previously enabled lines of communication are halted because management cannot visit facilities. Further insight is required, especially from higher levels of governance, in order to better understand the systemic contributors to this lack of communication and participation. Poor communication has been found as a barrier to high quality care delivery in multiple healthcare contexts (Kale and Kumar, 2012; Barker et al., 2017; Hignett el., 2018). In the context of the current study, a lack of effective and integrated communication, may therefore contribute to hindered performance and poor quality care outcomes (Leape, 1994; Vincent, 1999; IOM, 2001, 2003; Carayon et al., 2009; WHO, 2010; Carayon and Xie, 2015).

At the heart of the National Health Act of SA (2004), *decentralisation* is advocated through the establishment of district health systems where responsibilities and accountability has been formally shifted to district health management teams rather than individuals at higher levels. Furthermore, SA struggles to establish an effective health system where non-collaborative and central stewardship result in the majority of vertical health programs overwhelming managers at the local and district level and limiting their capacity to perform adequately (Managa, 2014). It is therefore imperative for health systems to ensure that district management teams are enabled with the ability to engage and communicate with sharp-end staff, in a way that is effective and promotes integration and decentralisation. Additionally, proposed solutions from participants who stated that management and leadership capacity should be built on, align with findings from Gilson et al. (2018) who suggested that well-trained and strong leadership across levels is required to facilitate the management and support of primary healthcare in developing countries, such as South Africa.

Job security

Many sharp-end stakeholders, specifically CHBC workers and nurses within the Sarah Baartman District, perceive issues related to job security to limit their work, as well as national healthcare delivery (table 11). These stakeholders indicate that they are recruited on contracts without permanent absorption into the health system, and fear for their [financial] job security. Low levels of job security can lead to increased stress, dissatisfaction and negative emotions that may be associated with low levels of job performance (Wang et al., 2015), and ultimately the inability to provide high quality care (Greenglass et al, 2003; Buerhaus et al., 2005). In parts of SA for example, Community Based Workers have reported dissatisfaction within the system resulting in a loss of motivation and performance (Etoori et al., 2020). In the Sarah Baartman District, CHBC workers who are hired on contracts report low levels of job satisfaction and motivation and are concerned by their poor job security and associated lack of access to benefits of permanent work, such as medical aid and better remuneration.

Participants who perceived these issues as high priority, proposed the “absorption of contract workers” to permanent posts. One participant commented that “we are running out of time age-wise and in service because government likes to ask what [experience] you have, so the years spent on a contract don’t count as service.” This implies that healthcare work done on contract is not seen as valuable experience to justify permanent appointment, despite many years of working on contract. Although not reported, such as scenario will likely contribute to increased feelings of hopelessness and unsatisfied staff, who may not be invested in the work they do, which ultimately affects the care they provide. This challenge may be related to poor management and leadership where appropriate managerial bodies are uninformed or misinformed about this concern, or don’t value the concerns of the staff involved and therefore may not make attempts to address this concern. For the stakeholders involved, not having the privilege of job security is an increasing threat because the low socio-economic profiles burdening many South Africans increasingly adds to the pressure to perform at work, contributing further to dissatisfaction, fatigue and the overall decreased desire to strive for high quality outputs.

5.1.2. Environmental barriers

The findings of the current research indicate that participants perceive environmental barriers related to poor levels of infrastructure, facility size, facility security, to limit both national, and local healthcare delivery (table 12). Barriers related to hygiene and sanitation were reported by CHBC workers, nurses and maintenance staff as barriers that limit their local performance.

Table 12. Environmental barriers to national and local healthcare

System component	Perceived barriers that limit healthcare provision	Definition
Environment	Poor infrastructure	Broken, run down or unmaintained buildings, toilets and waiting areas, small facilities with inefficient designs
	Security	Actual security of facility, staff and resources, including fencing, CCTV, and locks
	Hygiene and Sanitation	Unclean and unsanitized environments

Poor infrastructure

The current findings demonstrate that stakeholders from all workgroups are concerned about the state of healthcare infrastructure and how it may affect the provision of care both locally and nationally. Management staff reported on poor infrastructure as a barrier to healthcare provision both nationally and locally, which indicates that despite the abovementioned apparent lack of physical engagement between district management and sharp-end staff, management staff are aware of the poor infrastructure commonly reported. The sharp-end stakeholders who operate within the facilities provided more detail into what the specific infrastructure challenges are.

Comments such as “cracks in walls”, no patient toilets and poorly designed buildings and waiting areas to limit healthcare delivery were examples of this (table 12). A lack of functioning toilets for patients results in either the available toilets being ‘overused’, or it forces patients to feel uncomfortable or unsatisfied with facilities while visiting them. Cracks in the walls and steep walkways create hazards to either slip, trip or fall, or have infrastructure collapse. One participant indicated that wheelchair access is

limited as a consequence of the walkway being too steep. Moreover, these infrastructural issues also pose risks to patients and staff as one participant commented that in one area of the facility, the walls were so severely damaged that it could collapse, possibly injuring somebody.

Literature has found unfavourable work environments (Barker et al., 2017) and poor infrastructure to be barriers to effective healthcare in LMICs (WHO, 2008; Coovadia et al., 2009; WHO, 2018; Cronk and Bartram, 2018; Vaugh, Saint, Krein et al., 2019). Additionally, inadequate, and unreliable infrastructure in SA has been found to contribute to poor security, overcrowding and dissatisfaction from staff and patients (National Department of Health: NDoH; 2007; 2011). The inadequate maintenance of facilities could be linked to the reported concerns of staff around poor management and leadership where management may not visit facilities to observe and possibly address the challenges. The lack of funding and poor financial management would also contribute to this situation where improvements are not appropriately funded, or tenders are slow and unreliable. Adding to the inability to adequately maintain or service infrastructure in the Sarah Baartman District, could be the deep rural areas with rough terrain within the Eastern Cape. Poor road infrastructure affects access by rural communities and ambulances (ECDoH Report, 2018) and could limit improvement efforts.

Additionally, stakeholders from one facility stated that the clinic used to be an old school building. The physical design of a healthcare facility affects system processes by increasing waiting times and risks for inefficient or unproductive procedures (Reiling, 2006). In the Sarah Baartman District, stakeholders report that the facility being designed as an old school limits their performance, possibly due to space not being fit for purpose in terms of having enough consultation rooms or being able to handle the patient numbers.

Facility size

The size of a facility determines, to an extent, the capacity at which services can be offered. For example, poorly designed workplaces, waiting areas, and layouts may cause inefficient procedures (Paul, 2005; Carayon, 2016). This was certainly the case in the current study, as some admin staff in the Sarah Baartman District are expected to function optimally, despite not having space for document filing or the storage of

cleaning chemicals (table 12). Moreover, nurses who do not have rooms for consultations, and pharmacists who waste time walking around obstacles to fetch commonly needed medication, cannot work efficiently in order to serve their patients. These issues may result in sensitive patient information being heard by other staff or patients and the overall care processes being unprofessional, delayed or both. The lack of space for filing patient records, experienced by admin staff, may result in lost or stolen records as well.

The current findings were echoed in the study Hignett et al. (2018) which found that healthcare providers perceive limited space in facilities to limit performance of the NHS by making materials inaccessible or difficult to locate in a timely fashion. Furthermore, examples of poor lay out have been found in other parts of South Africa: Heunis et al. (2006) stated that some clinics in SA are not designed for the provision of primary healthcare services, resulting in poor maintenance and workflow in many facilities. Another study on the community's perceptions of quality healthcare services, conducted in the Limpopo province, revealed that small buildings were inadequate to provide a good service. Additionally, Klopper et al. (2016) stated that safe care cannot be rendered in overcrowded healthcare facilities, which was a common report from many participants within the Sarah Baartman District where small or inappropriately designed facilities contributes to overcrowding.

A CHBC worker proposed that government could implement outside "tents" for patients to be seen when patients overflow out of the facilities. Other participants indicate that to address this issue either more facilities need to be built or renovated to allow for more waiting areas, consultation rooms, offices, and storage space. Karsh (2009) found that through simple workplace redesign, improvements to clinical practice and workflow would support clinical decision-making and ultimately outcomes. In the current context however, the feasibility of such efforts may be potentially challenging considering financial constraints faced by the health system (Managa, 2014). In spite of this, addressing these issues through arranging the workspaces differently may be something that the local Department of Health may need to consider for future improvement efforts.

Facility security

Another barrier related to the environment component reported by sharp-end staff was the perception of limited physical security such as fences, gates or storage cabinets to protect staff and resources (table 12). Security in health facilities in SA remains a concern as it has to cover both the patients and health providers. Security issues in the Sarah Baartman District included not having a fenced off facility, which increases the risk for crime and freely moving domestic animals (cows and goats) that interfere with the function of the facilities and its staff. Facilities are required to be locked and secured overnight to protect resources as well as in the day during operations to protect staff and equipment. A lack of such security infrastructure, together with limited security personnel adds worry and concern to sharp-end stakeholders in the Sarah Baartman District who reported being fearful of being robbed, abused, or harassed during work. The current findings are similar those of Leon et al. (2002) who reported that primary healthcare facility managers are concerned about a lack of security and crime, and highlight concerns about hijacking, stolen cars, stolen babies and threatening of staff in facilities. Additionally, the concern for sharp-end stakeholders' security in the Sarah Baartman District, are echoed by findings from Ijumba (200) that reported on how nurses in primary healthcare facilities in SA are three times more likely to experience crime and violence in the workplace than other occupational groups.

In the current context, the lack of security could be the result of multiple factors, such as a lack of security staff, management not ensuring adequate maintenance of existing infrastructure, as well as inadequate funding or miscommunication. As stated by one security staff member, they are not supplied with adequate self-defence equipment and when community members "come with guns" the security staff "run away in fear". This reflects the reality of the unsafe environments faced by sharp-end staff in some contexts of SA. Working in such unsafe environments adds concern and uncertainty, which shifts focus from striving for high quality as stakeholders constantly need to worry both staff and patient safety.

Hygiene and sanitation

General hygiene and sanitation of the facilities was identified as a concern by a variety of sharp-end staff to limit their performance (table 12). For instance, stakeholders reported that a septic tank outside their facility constantly leaks, which affected their

ability work, possibly due to air pollution and germ exposure. Leaking sewage may also deter patients from coming to or staying the facility or delay healthcare processes in an attempt to avoid spillage or contamination into the facility. The perception among various stakeholders is that the hygiene and sanitation levels of facilities themselves are not up to standard. Participants report that their facilities are not adequately cleaned and may affect care at a national and local level. This is possibly due to a lack of cleaning staff and cleaning equipment and results in facilities not being appropriately sanitized in timely manner. Effective infection control measures and practices, especially through hygiene and sanitization are crucial to the provision of safe and effective care (Allegranzi et al., 2011; Barker et al., 2017; Kenzie et al., 2018). Despite the management processes and requirements for infection control, not having appropriately sanitised environments, either from a lack of cleaning staff or cleaning equipment, increases the risk of stakeholders being exposed to hazardous human or chemical waste, which increases the risk of infection (Allegranzi et al., 2011; Barker et al., 2017).

Many facilities in LMICs lack adequate sanitation and infection control measures (WHO, 2018) and literature around challenges to South African healthcare delivery have reported poor environmental hygiene as a common concern (Mayeng and Wolvaardt, 2015; Coovadia et al., 2009). In the case of the Sarah Baartman District, these barriers may be the result of the intersection of the mismanagement of funds, poor communication, or a lack of accountability within management. In spite of the possible causes, the Local Department of Health need to ensure that facilities are enabled with the appropriate capacity to achieve hygiene and sanitation standards either through appropriate staff management or procurement of cleaning materials.

5.1.3. Tool and technology barriers

Equipment and resources

The findings from the current research demonstrate that stakeholders report that a lack of tools and equipment (including “resources”, which include consumables such as stationary, toilet paper, or cleaning products), limits healthcare delivery both nationally, and locally (table 13) typically by not limiting specific work processes for example, certain medical procedures, administrative work, or cleaning.

Furthermore, these issues are experienced differently across work groups, for example, CHBC workers and maintenance staff highlighted a lack of uniform, personal protective equipment (PPE) and transportation, while pharmacists report on a lack of information technology (both hardware and software) and medication as barriers to their work and other healthcare staff nationally. A lack of uniform, including PPE, reported by CHBC workers may limit a sense of ownership and empowerment to do their job within the community, while also increasing the risk of CHBC staff being exposed to and contracting diseases such as Tuberculosis (TB) or other infectious diseases during their interactions with the community. For security staff, there was concern over a lack of self-defence equipment necessary to protect themselves, fellow staff, or the facility they work in.

Table 13. Tool and technology barriers to national and local healthcare delivery

System component	Perceived barriers that limit healthcare provision	Definition
Tool and Technology	Broken or unmaintained equipment	Equipment that is broken, unmaintained (such as old computers) or medical devices not calibrated or serviced
	Lack of equipment	Including medical devices, information technologies such as computers or printers, filing cabinets, transportation, uniform, and general cleaning equipment
	Resources	Including a lack of medication, stationary, and commodities such as toilet rolls, and cleaning materials

Moreover, a lack of available transport results in CHBC workers having to walk far distances, often in harsh environmental conditions, while potentially facing the risk of being robbed, just to provide basic care. Similarly, a lack of transport limits management from visiting surrounding clinics. Management staff report that without adequate transport, they cannot visit clinics to offer support and mentorship. In many cases, management adapt by “car pooling” where they share transport, as they have to often travel far distances (40-55km, appendix G) to visit the district facilities. This lack of transportation for management limits managers from visiting the facilities and

contributes to the perception that there is poor communication and that management are disconnected or don't care. A lack of available transport may result from a number of factors, including the abovementioned financial constraints, or poor management and leadership where provincial or national management may not be aware of these barriers.

Furthermore, stakeholders in the Sarah Baartman District mentioned a shortage of computers in consulting rooms, printers and stationery as barriers. Many nurses report that medical equipment is often broken, uncalibrated before use, or unmaintained, which limits their ability to ensure adequate, reliable and effective care. Additionally, with many facilities lacking working printers or scanners, some health workers are unable to print consent forms for patients with HIV. This severely delays processes and patient care, or possibly leads to violations of protocol (where patients are tested without written consent). Recent studies indicate that a lack of administrative equipment such as computers, stationary and printers, as well as material resources, equipment and supplies experienced by many primary healthcare facilities in South Africa, result in limited processes, prolonged patient stays, ultimately adversely affecting the quality of healthcare delivery (Manyisa and Van Aswegen, 2017; Etoori et al., 2020).

The findings of this study are comparable to other studies from high-income countries, such as United Kingdom's NHS (Carayon and Xie, 2015; Hignett et al., 2018) and Norway (Odberg et al., 2020), where a lack of resources and equipment has also been reported to affect healthcare delivery. However, this equipment typically refers to information and communication technology (ICT's) and sophisticated technology and medical equipment, such as ventilators or self-administering medication pumps (Carayon and Xie, 2015; Hignett et al., 2018; Odberg et al., 2020). In contrast, this study highlights how more basic, fundamental equipment and technology is lacking.

Moreover, stakeholders in the Sarah Baartman District highlighted a lack of working tools and equipment as barriers both locally and nationally, while also mentioning the "equipment graveyards" (wasted space) a term that has featured in other research in certain public health facilities in LMICs (Perry and Malkin, 2011). The current findings support those from Heunis et al. (2006) which stated that in SA, some equipment such

as examination lights were in short supply in many facilities, whilst in other cases, the maintenance of equipment was poor.

Furthermore, admin and management staff in the Sarah Baartman District experience delays when placing orders for cleaning materials and equipment and perceive similar barriers to limit national healthcare delivery. Similar findings have been reported from the UK where health providers perceive non-seamless and non-user-friendly information technology (IT) to limit the purchasing and ordering of products (Hignett et al., 2018). A lack of cleaning materials and equipment results in the inability to ensure effective facility cleanliness and hygiene, which increases the risk of infection (Allegranzi et al., 2011). Participants who reported on a lack of tools and technology as *high priority* challenges to healthcare in South Africa commonly propose that in order to overcome these challenges, adequate resources need to be supplied by government and management to the facilities and staff and that staff should be adequately trained to use equipment and systems when they are supplied. A security officer proposed that their ‘company’ should provide them with protective equipment so to facilitate their performance. Participants also propose that at both national and local levels, equipment should be continuously maintained, serviced or repaired. Locally, participants propose that management need to agree to meet needs of uniform allocation, necessities such as toilet paper, computer upgrades and perform appropriate equipment diagnostics in facilities to ensure equipment is adequate.

Medication

A challenge commonly reported in literature in South Africa (Coovadia et al., 2009; Manyisa and Van Aswege, 2017; Maphumulo and Bhengu, 2019) and now in this study is the non-availability of medication where inadequate procurement processes and shortfalls in supply chains severely affect facility medicine stocks, which in turn, may influence care provision. Participants in this study, specifically pharmacists reported on shortfalls in supply chains, inadequate medication budget and misinformed procurement of medication, all of which result in a lack of medication availability.

Pharmacists within the Sarah Baartman district report that government should allow them to order more medication directly from the depot rather than experience delays.

5.1.4. Person-related barriers

In light of health system goals, healthcare is primarily person-centered, where care processes and outcomes are determined by efforts from both patients and healthcare providers and support staff. Person-related factors that contribute to work system processes and outcomes may therefore be at the level of the provider (including management), or at the patient. In the current study, stakeholders from within the Sarah Baartman District identified the following person/people-related challenges: *community health and education*, patient *behaviours and attitudes,* and *patient variability* (table 14).

Table 14.Person related barriers to national and local healthcare provision

System component	Perceived barriers that limit healthcare provision	Definition
Person	Patient variability	Different languages, cultures, and diseases each with unique journeys
	Patient behaviours	Alcohol and drug abuse, non-compliance to medication guidelines and booking systems and neglectful attitudes to staff
	Community health and education	Poverty, uneducated and undernourished members of the community unable to invest in care, as well as pressure of health burdens (HIV, TB)

Community health and education

The theme 'community health and education' was a common barrier reported across all workgroups. Management staff described barriers around "*high levels of poverty"* and *"patients [being] uneducated regarding their own health*" while a nurse reported that "*unemployment levels in the community are high*".

Poverty has a large impact on health determinants of South Africans where poor nutrition, income, housing and sanitation influence the lifestyle and behaviours, ultimately contributing to poor health outcomes (Sekhampu, 2013). Additionally, South Africa faces an unusual quadruple burden of diseases, namely: maternal and child mortality; communicable diseases such as HIV/AIDS and TB; non-communicable disease such as hypertension, heart diseases, diabetes and cancer; as well as

violence and injury, arising from a combination of pre-transitional diseases and conditions related to poverty and underdevelopment (Bradshaw et al., 1992; 2003; Norman et al., 2007; DoH, 2017).

In the current study, the perceived challenges related to community health and education are therefore associated to socioeconomic status (SES) of the population which the majority of these facilities service (Link and Phelan, 1995; Fiscella et al., 2000). The relationship between SES and healthcare quality has been documented before but is beyond the scope of this thesis (see Fiscella et al., 2000). SES is a complex and multifaceted construct, commonly assessed using measures of educational achievement, household income, or occupational prestige (Oakes and Rossi, 2003) and is therefore a powerful determinant of public health, healthcare processes, and healthcare outcomes (Link and Phelan, 1995).

Low levels of community health and education may impact care outcomes in multiples ways and although this was the not the focus of the current study, it is important to acknowledge these issues. For example, community education levels may impact care processes at the level of the provider, where a physician may spend less time with less educated patients on asking questions or assessing patient health knowledge despite the potentially greater need by less educated patients (Fiscella et al., 2002). Moreover, poor community health and education may possibly impact care processes at the level of the patient where individuals from a lower SES may in some cases rely on or only have access to health facilities that may not be adequately staffed or resourced and provide lower quality care, possibly due to geographic or financial barriers (Link and Phelan, 1995). Furthermore, the ability for patients to obtain, understand, process and effectively use health information is referred to as health literacy (Kindig et al., 2004). In contexts where patients have low levels of health literacy, possibly due to issues associated with SES, knowledge of risk factors, symptom recognition, and the ability to navigate healthcare systems may be negatively affected. Low levels of community health and education and SES are therefore complex, interconnected and are rooted in SA's apartheid history. These are important factors that may interact and affect the quality of care that is provided and should be considered by all healthcare stakeholders when attempting to understand and improve on healthcare delivery.

Patient behaviours and attitudes

Stakeholders from the sharp-end within the Sarah Baartman District mentioned poor behaviours and attitudes of patients limit safe and effective healthcare delivery. Poor attitudes of patients have been reportedly linked to poor health outcomes by hindering patient involvement (Greenfield et al., 1985; Greenfield et al., 1988) or compliance (Horwitz. 1993; Fiscella et al., 1998). These risks are evident in the current context where nurses, pharmacists and admin staff commonly reported that many patients do not adhere to appointments or comply with recommendations for medication. Furthermore, these issues create other challenges around staff workload and overcrowding: for example, when patients don't honour their appointments and just 'pitch up' expecting to receive care when there are other patients waiting for care. Poor patient behaviours are also related to the availability of medication, specifically when patients who don't collect, or take medication properly, results in over- and under- use of medication. This in turn, may perpetuate the abovementioned challenges around poor community health as a result of poor medication taking and compliance.

Issues related to negative behaviours and attitudes may be related to abovementioned issues of SES and education where alcohol or drug use, disrespect and non-adherence to medication and appointments limit the ability to ensure high quality healthcare. Participants within the Sarah Baartman District report violent and negative behaviours by certain patients that make staff feel unsafe and stressed while at work, which may influence their ability to focus on care provision. One participant highlighted this in a comment stating "*when someone from outside comes in with guns, we run for our lives leaving the nurses behind".*

Furthermore, in light of the low levels of community health and education reported across all workgroups, one CHBC worker from the current study proposed that disseminating flyers or informative pamphlets about health-related issues, that are designed with and for the local population may help to improve the challenges associated with poor community health literacy. In light of these barriers and proposed solutions, it is important for the DoH and other stakeholders to continue to work towards improving health literacy in the community through the use of informative material tailored to the literacy, linguistic and cultural needs of the population. This is especially important for CHBC workers whose roles involve interacting with and educating

community members around health issues and as reported by CHBC workers, emphasis should be placed on improving these aspects of their work.

Patient variability

Another person-related barrier perceived among sharp-end stakeholders within the Sarah Baartman District relates to patient variability. More specifically, the participants commented on barriers related to how language and cultural values affect the care process (table 14). For example, a nurse commented that some patients are hard to understand, while another reported on how language barriers slow down their care processes by hindering communication about healthcare. This may stem from the fact that a large proportion of the population that are treated in these facilities are isiXhosa speaking and do not have to (or need to) speak English regularly. Thus, staff may struggle to communicate information about healthcare or medication and if patients do not fully understand, there may be a risk for poor quality care delivery, possibly because patients may not understand how to adhere to instructions given. Conversely, health practitioners may have difficulty understanding some patients when they are describing symptoms or conditions.

Moreover, the variability across patients may also refer to the co-occurrence of medical conditions, the abovementioned consequences of poor SES, cultural, behavioural, and environmental circumstances, each which contribute to patient complexity and in turn, affects how patients receive and respond to care (Safford et al., 2007; Boivin et al., 2017). For providers, these barriers may contribute to uncertainty as to how to clinically engage with and treat patients (Carrillo et al., 1999; Boivin et al., 2017) resulting in staff being culturally insensitive to patients (Lannin et al., 1998), or miscommunicating due to language barriers (Fiscella et al., 2002).

Poverty, unemployment, poor education, insufficient housing characterize the social determinants of health in the Eastern Cape Province of SA (ECDoH Report, 2018). In the context of the Sarah Baartman District, person factors that are perceived to be barriers to work (table 14) are therefore associated with low SES, culture, language and behaviours of patients, all of which have been shown to negatively effect care interactions (Fiscella et al., 1998; Lannin et al., 1998; Fiscella et al., 2002; Safford et al., 2007). These factors are therefore important to understand when designing for safer systems. The current findings suggest that in the context of the staff in the Sarah

Baartman District, more effort is needed to ensure adherence to established care guidelines, effective communication and cultural sensitivity to improve patient and staff interactions within the health system.

5.1.5. Task barriers

Stakeholders from the Sarah Baartman District reported high workloads, high-risk work and task difficulty as major concerns in relation to the 'task components' necessary for the provision of care (table 15).

Table 15. Task-related barriers perceived to limit national and local healthcare in SA

System component	Perceived barriers that limit healthcare provision	Definition
Task	High workloads	The demands of work placed on an individual in relation to burnout, role shifting and fatigue (this refers to the perceived demands of work and not the organisation of the work, hence a task factor)
	High risk work	Factors that risks the physical safety such as exposure to dangerous diseases and environmental elements, and to violent and abusive members of community.
	Task difficulty	Ensuring that tasks are performed with ease is challenged by a lack of resources and poor infrastructure.

High workloads

In the current study, workload refers to the perceived workload demands that the tasks place on the individuals, rather than the way that work is formally organised (Carayon, 2009), or prescribed (Shorrock, 2019). Participants from all workgroups report that their workloads are excessive, resulting from staff having to shift roles or do two peoples work (table 15). While likely the result of the interaction between many of the above-mentioned barriers the current findings suggest that the demands of normal work are increased as providers are required to shift and share roles, while attending to high numbers of patients, which in turn are likely to result in additional cognitive and physical strain. If sustained, and combined with additional systemic stress from factors such as job insecurity, a lack of equipment or patient complexity (Safford et al., 2007), these barriers may contribute to increased levels of fatigue and burnout and ultimately hinder

the ability to ensure high quality outcomes (Yassi and Hancock, 2005; Carayon and Gurses, 2008; Van den Hombergh et al., 2009; Hoben et al., 2016; Boivin et al., 2017).

This may also partially explain the dissatisfaction with management and government in the Sarah Baartman District, all of which hinder the ability to ensure appropriate processes and outcomes (Halbesleben, Wakefield, Cooper, 2008; Klopper et al., 2012; Coetzee, Klopper, Ellis, Aiken, 2013; Wilson, 2015). The high workloads experienced are thus likely the result of various systemic challenges such as a lack of staff, poor management and leadership, financial mismanagement, or disconnected leadership where challenges, and barriers are not adequately addressed and ultimately contribute to poor quality outcomes.

High risk work

Sharp-end stakeholders, typically maintenance staff and CHBC workers commonly reported on the perception of high-risk work as a barrier to their local performance and healthcare nationally. CHBC workers are responsible for visiting patient homes and experience challenges relating to the provision of PPE, transport and uniform, report on high risk work as being exposed to weather without transport, diseases such as TB without PPE or violent / abusive members of the community without security personnel. Furthermore, security personnel report that their work is high risk as they are required to perform processes (security work) without protective equipment. Performing tasks under such conditions results in “difficulty” to perform. Perceiving work to be high risk is both good and bad, as it may imply that being aware of the risks may enable opportunity to take the necessary precautions to avoid them. However, this also highlights how a lack of PPE or transport, may result in the inability to avoid certain risks associated with walking long distances, being exposed to poor weather conditions, with valuable medical resources, to potentially ill or abusive clients.

The nature of healthcare work has been reported to be hazardous where providers risk infection (Puro et al., 2001), and in the case of the current findings, stakeholders have to navigates challenges related to violence and fatigue, mental health issues and burnout. Additionally, the lack of appropriate hygiene and sanitation may contribute to increased risk of infection. It is therefore important for the Department of Health to ensure that working conditions and environments are safe and enable migration away from emergent risks. The local DoH therefore needs to ensure that health providers

and facilities are supplied with adequate PPE and equipment to ensure safe environments and performance of high-risk processes.

Task difficulty

A common theme reported by all participants within the Sarah Baartman District was that of task difficulty. Sharp-end staff report that the performance certain tasks is difficult or challenging due to a lack of resources and adequate infrastructure (table 15). For example, one participant reported that obtaining consent is difficult to do because there is no photocopy machine. They have to either figure out an alternative way to obtain consent for HIV testing, or in the worst cases, report that they have to do HIV testing without consent. Similarly, in some healthcare clinics in the Mpumalanga province of SA, home-based care workers reported that they have trouble when documenting the tracing of patients properly due to a lack of photocopy machines (Etoori et al., 2020). In the Sarah Baartman District, this perceived difficulty could be a result of a combination of barriers, including possibly a lack of training, poor resource procurement or poor communication with and from management.

These findings align with Hignett et al. (2018), who found that healthcare providers in the NHS perceive that increasing numbers of patients results in difficulty in making time for thinking and planning around care. This is supported by reports from a nurse participant referring to the trade-off between work quality and quantity. The difficulty to do tasks is likely due to shortfalls in the system such as lack of staff or equipment, or a lack of training where being unprepared or unaware how to navigate through certain situations, may result in difficulty to do the tasks and ultimately risk unsafe or inefficient procedures.

The abovementioned findings suggest that there are multiple systemic barriers at different levels in the Sarah Baartman District. While it is important to understand these barriers at different levels, and although not necessarily the focus of this study, it is also important to stress the need for the knowledge related to them to be effectively integrated across levels in order to facilitate improvements and quality outcomes (Rasmusssen, 1997; Badimo and Buckley, 2014).

5.1.6. Elaborating on vertical integration in the Sarah Baartman District

The current findings suggest that although many of the perceived barriers across management staff and sharp-end staff are similar, there are also areas where there is a possible lack of integration and understanding. For example, a comment from a participant stated that “staff are not included in policy formation” which reflects a lack of participation in the decision that affect how work in this context is performed. A core principle taken by HFE and quality improvement is that of participation (Xie and Carayon, 2015) where the design and implementation of policies, technologies or environments considers the participation and input of the people who do the work (Vink et al., 2008; Van Eerd et al., 2015). Including the people who do the work in policy formation may ensure that work as it is imagined, designed or prescribed (Shorrock, 2019) is as close as possible to work as it is done (Hollnagel et al., 2015; Catchpole and Jeffcott, 2016; Shorrock, 2019).

The assertion of a potential lack if integration is further supported by the perception of job insecurity, reported by CHBC workers and nurses as a barrier to healthcare provision in SA, which management staff did not report on as a barrier to healthcare in SA. It is important for blunt-end stakeholders to be aware of the barriers faced at the sharp-end so that they can effectively respond to them and mitigate their associated risks (Rasmussen, 1997; Reason, 2000). Job insecurity is one such barrier that management should be aware of as the consequences thereof (Wang et al., 2015) may contribute to demotivated, dissatisfied staff, which may ultimately affect the level of care provided (Greenglass et al, 2003; Buerhaus et al., 2005). Although this could be due to the small sample of management staff (n=5), it suggests that district management may not be fully aware of, or fully understand some of the barriers that sharp-end stakeholders perceive to limit healthcare in SA.

To effectively manage emergent risks in complex systems, Rasmussen (1997) argues that vertical integration of information related to hazards and barriers is needed across all levels. Vertical integration and integrated care have been associated with higher performance on some measures of quality in various contexts (Hu, 2009; Shaw et al., 2011; Hwang et al., 2013; Badimo and Buckley, 2014; Machta et al., 2018). Furthermore, Cong et al., (2007) and Kim et al., (2012) contend that the effective functioning of government rests on effective sharing and use of knowledge by public

sector employees at various levels, central or local. A lack of vertical integration, or knowledge sharing, may therefore contribute to an iceberg of ignorance (Yoshida, 1989), where management may not be aware and thus unable to address the problems at the sharp-end. This may be the case in the Sarah Baartman District where, due to a sharp-end staff not being included in policy formation and other important decisions or actions that impact their work directly, management may not fully understand what the concerns are at the point of care. District management, whether clinical or non-clinical, act as “middle men/women” between the sharp-end and Provincial or National Department of Health. They need to have a good sense of real conditions and concerns at the sharp-end, and a clear pathway for effectively enabling dissemination of information related to the risks and barriers to all relevant stakeholders. It is therefore important for district management to be aware of and disseminate the knowledge around these barriers to appropriate stakeholders to allow for them to be responded to.

According to the South African National Guideline for Patient Safety Incident Reporting and Learning (SADoH, 2017), all health professionals should report incidents as soon as they become aware of them to ensure that optimal learning takes place. The guidelines adopted by the South African Department of Health provide direction to the health sector of SA regarding the management of incident reporting, including the provision of appropriate feedback to patients, families, teams and clinicians, and the sharing of lessons learnt to prevent poor quality outcomes (NDoH, 2017). The guidelines describe a national standardised system for managing incidents to ensure that various levels of care in the health system respond effectively.

Similarly, as for the occurrence of incidents, effective lines of communication related to the hazards or barriers that stakeholders perceive to limit their performance, need to be established to allow for them to be made explicit and responded to by appropriate levels of stakeholder. By doing so, patient safety outcomes and work environments may be improved by facilitating the integration of knowledge around both latent (and active) failures and emergent hazards in the healthcare system (SADoH, 2017). In commercial aviation, airline crews (sharp-end workers) have learned to speak up and raise concerns, contributing to significant safety improvements in safety and quality (Wachter, 2012). In the same light as incident reporting, stakeholders at the sharp-end

should be encouraged to voice their problems and management staff should be enabled to respond effectively, if this is not the case in the Sarah Baartman district system. However, this was beyond the scope of the current study. Future efforts are needed to better understand the various systemic facilitators and barriers around the management and dissemination of knowledge related to problems faced by sharp-end workers within the Sarah Baartman District.

5.1.7. Systemic nature of barriers in the Sarah Baartman district

Wilson (2013) emphasizes that HFE is about optimizing systemic interactions between human, technical, information, social, political, economic and organizational components within a system. That is, HFE is less about the system elements than it is about the interactions that these elements create (Carayon et al., 2013; Wilson, 2000; 2013). HFE is a systems discipline (Hollnagel, 2016; Carayon and Xie, 2014; Wilson, 2014), however as stated by Wilson (2013), “good ergonomics is system ergonomics” implying that effective and comprehensive application of HFE can only be achieved by considering system-wide interactions. It is evident, that through the Work Systems Model as a framework, the challenges faced by staff in this context are systemic and wide-ranging.

A lack of finances, likely from provincial or national level constraints (Coovadia et al., 2009; Siddle, 2011; Managa, 2014), likely means that the Sarah Baartman District system operates under financial strain, which may affect the recruitment of necessary staff, the maintenance of facilities, procurement of resources, and management or leadership capacity to effect change in the facilities. For example, a lack of transport, possibly due to financial constraints, no accountability or poor communication from higher levels, may result in district management staff having to “carpool” or delay their visits to clinics. This in turn may result in sharp-end staff perceiving management as uninterested, disengaged and uncaring because they cannot address issues such as poor infrastructure / equipment or hear staff problems. This lack of support may further contribute to staff dissatisfaction with the system and ultimately foster a culture where staff may be reluctant to report further potentially increasing the risk for poor outcomes (Buerhaus et al., 2005; Carayon, 2008).

Furthermore, a possible lack of finances or appropriate leadership in higher levels may contribute to slow procurement processes (Coovadia et al., 2009; Managa, 2014). If

management within provincial or national levels are uninformed, misinformed, or are limited by financial resources, this could affect the supply of resources, such as transport or cleaning equipment. At a district level, this can be highlighted with the current findings which suggest that slow procurement processes results in the inability to deliver healthcare, maintain or clean facilities and in turn contributes to poor hygiene or security, ultimately contributing to the risk of infection or dissatisfaction among staff and patients.

Lastly, in the Sarah Baartman District, factors such as patient complexity and low SES add to the complexity of delivering care. When combined with high workloads and increasing levels of dissatisfaction with the system, increase the risks for poor processes and outcomes where staff may lack certain skills, be fatigued, or reluctant to strive for high quality care, or where facilities are under maintained, unhygienic or dangerous (WHO, 2008; NDoH, 2011; Barker et al., 2017; Cronk and Bartram, 2018). These interactions may therefore, in turn, result in staff who are unmotivated and overworked, or who risk being infected, which puts further strain on existing staff to provide care to high number of patients.

5.1.8. Further implications and evidence of change through research engagement

In light of the systemic barriers highlighted above, this study is therefore useful as a basis for discussion around the importance of understanding system interactions among healthcare personnel at all levels of healthcare and how improvements can be achieved through consideration of HFE and its approaches (Dul et al., 2012; Wilson, 2014). By understanding these barriers with an HFE perspective, the current study findings may guide future research or improvement efforts from within the local Department of Health, from those in training to sharp-end staff and senior management.

It is especially important in resource-constrained contexts, such as the Eastern Cape Province, to implement interventions that are most likely to be impactful. Meadows (1999) argues that within complex systems there are places, termed “leverage points” (p. 2), that when small shifts occur, result in large changes in everything else. It is argued that people in the system typically know what these leverage points are, for example when creating policy, or understanding relationships between supplying and

sales force. Participatory and user-centered approaches enable these insights to be considered (Haines et al., 2002; Van Eerd et al., 2016; Vosper et al., 2018). Exploiting these leverage points may therefore offer unseen passage for improvement by offering effortless and effective system wide change (Meadows, 1999). For example, during conversations with the local collaborator (LC), it was pointed out by the LC that being introduced to various HFE concepts and approaches (specifically the Work Systems Model and the Risk Management Framework; Rasmussen, 1997; Carayon, 2009), they had consequently made a concerted effort to incorporate the views of various sharp-end workers in subsequent staff meetings. The LC noted that they had considered the benefits of understanding and integrating these perspectives and it had changed the way they approached their work. This is an example of how through the process of collaborating with and educating management on HFE, a possible leverage point related to changing mind sets or affecting information flow and knowledge management (Meadows, 1999) may be influenced to enable and better address the barriers to healthcare provision in the Sarah Baartman District.

Similarly, the physical design of healthcare facilities in the Sarah Baartman District contribute to poor workflows, long waiting times, overcrowding and dissatisfaction. Through participatory and systems-orientated design approaches (Haines et al., 2002; Dul et al., 2012; Wilson, 2014; Van Eerd et al., 2016), the simple redesign of health facilities may act as an influential leverage point by possibly improving workflows and issues related to overcrowding, long waiting times, and staff and patient dissatisfaction (Xie and Carayon, 2015). Based on the abovementioned findings, as well as researcher's observations and interpretations from visits to the various healthcare clinics, considering physical redesign of waiting areas and administration offices may alleviate some of these challenges. Future research and collaboration is needed to better understand how the design of clinics in the Sarah Baartman District affect system performance and outcomes.

Furthermore, recognition of major barriers related to staffing and staff training, local stakeholders should commit and emphasise the importance of providing regular staff training, recruitment of staff on contracts, staff empowerment, and staff satisfaction. Support and commitment from district, provincial and national leadership is needed to implement policy that incentivises healthcare worker retention and recruitment. The

Department of Health also should engage with regulatory and government bodies and training institutions to accelerate the development and qualification of health practitioners; and implement ways to absorb contract workers into the health system as permanent workers in order to contribute to a more satisfied, reliable and competent workforce. This supports the assertions made by Sithole and Mathonsi (2015) who argued that for local government to deliver on its constitutional mandate, government needs to strengthen human and material resources in terms of quality and quantity. Additionally, the absorption of contract workers into the health system as permanent staff may be a significant leverage point in which the health system may focus on workforce quantity and quality though facilitating the retention of staff and enabling their CPD and satisfaction so to ensure long term quality improvements. Future research and guidance is however needed to better understand the mechanisms and constraints around contract workers within the Department of Health in order to substantiate the argument of such a leverage point.

As noted above, the capacity of health systems and management teams may be limited by constraints at higher levels, however it is imperative to promote the procurement and budgeting for healthcare vehicles and resources, appropriate training, and leadership that promotes positive organizational culture. The allocation of resources (and associated training on use) such as uniform, PPE, transport, and cleaning materials may undoubtably improve the capacity of local healthcare workers, facilities, and management teams in the Sarah Baartman District.

At the level of the sharp-end, training initiatives should supply clinicians with context specific strategies (that can only be effective with HFE) that may preserve safety when ‘normal’ becomes impossible. For example, learning how to gain consent when there is no printer or paper available so to ensure that processes are ethically sound and that risks are minimized; or introduction of healthcare “huddles” at each staff shift, adjusting team roles and priorities to best adapt to pressures and role shifting (Cracknell et al., 2016). These may elevate pressures faced by sharp-end workers in situations where barriers may emerge. For example, being equipped with the capacity to obtain HIV testing consent using a logbook in a confidential manner may remove the legal risks associated with administering HIV tests without written consent. Similar strategies have been used in clinics in Mpumalanga Province where CHBC workers

use logbooks to trace patients when printers are unavailable (Etoori et al., 2020). The Local Department of Health needs to further explore context specific barriers that emerge and work in a participatory manner in designing training strategies that equip sharp-end staff with knowledge around alleviating the consequences of context specific barriers. As for sharp-end stakeholders, it is also important for to be aware of the importance of being responsive and appropriately speaking up about problems, so to facilitate sustainable improvements to quality care (Daniels et al., 2017).

HFE has been used in healthcare globally in multiple interdisciplinary ways to facilitate the design of work systems for improvements to quality (Fewster-Thuente and Velsor-Friedrich, 2008; Gurses and Carayon, 2009; Hignett et al., 2013; Xie and Carayon, 2015). Similarly, future efforts by the Department of Health in SA at all levels should consider collaborating with HFE professionals to better explore, understand and improve on context-specific barriers and develop cost effective implementation of ways to best respond to or leverage them.

An intention of the researchers was to engage with the LC in local context following the completion of the study and discuss the findings and possible future research and implementation ideas. This process was unfortunately halted due to the emergence of a global pandemic, which has significantly pressurized global health systems and now, at the time of writing this thesis, the local Sarah Baartman district. The study findings, implications and future directions therefore need to be considered in light of the pressures added by the COVID-19 pandemic, discussed below.

5.2. Current Context (COVID-19)

In December 2019, an outbreak of unexplained cases of pneumonia and respiratory disorders was reported from Wuhan in the Hubei province of China (WHO, 2020). By January 2020, the etiological agent was identified as the novel Corona Virus (SARS-CoV-2), where the set of symptoms was termed COVID-19 (WHO, 2020; Alegbeleye and Mohammed, 2020). With time, the COVID-19 outbreak transitioned from an epidemic to a pandemic, with infections and mortalities increasingly identified globally (Sohrabi et al., 2020; WHO, 2020).

The association between COVID-19 mortality and healthcare resource availability in China has been emphasised, where researchers highlight that in which areas with

limited healthcare resources, there were higher mortality rates (Ji, Ma, Peppelenbosch, 2020). Equally, rapid escalations in the number of infections revealed insufficiencies of healthcare resources (such as hospital beds, ventilators or PPE), factors which also negatively affected patient and staff outcomes. Due to the infectious nature of COVID-19, sharp-end workers are some of the most vulnerable (Walton-Roberts, 2020). This is supported by reports of how nurses in the US are contracting and dying due to COVID-19, which demonstrates how dangerous a lack of PPE is (Bowden, Campinile, Golding, 2020; Walton-Roberts, 2020). Nurses were reported to be wearing garbage bags in place of gowns in an attempt to manage risks of infection while attempting to provide much needed care (Walton-Roberts, 2020). In light of this, it has been suggested that certain parts of Africa may be at risk of facing even more sever and under detected outcomes related to COVID-19 as the continent's countries are amongst those most at risk of widespread disease threats (Alegbele and Mohammed, 2020; Sohrabi et al., 2020).

The findings from the current research, together with emerging grey literature and news reports, point to serious problems that the Sarah Baartman District and more broadly, the Eastern Cape health system faces in light of COVID-19. High patient numbers and poor infrastructure, together with a lack of resources, particularly PPE, cleaning equipment and transport experienced in the Sarah Baartman District may severely limit the ability for health providers to ensure that the environments in which they work and the care that they deliver is safe for everyone involved. Furthermore, a lack of staff, high workloads, burnout and dissatisfaction also perceived by stakeholders, increases the risk of inefficient and unsafe procedures, further adding to the burden of COVID-19.

Additionally, emerging grey literature from the Easter Cape province indicates that the surge of COVID-19 has brought to light and amplified many systemic problems faced within the system, such as those highlighted in the current study (figure 13). For example, national news reports highlight how CHBC workers in the Eastern Cape have been protesting and calling for permanent work appointments and PPE, while other health providers have stated their dissatisfaction with the system around ensuring adequate hygiene and sanitation as well as corruption from leaders (SABC News, 2020).

A lack of transport for health providers and patients, and issues of poor leadership and communication have also been highlighted. According to The Herald, a local news report in the Eastern Cape (HeraldLive, 2020), in preparation for the anticipated pressures from Covid-19, the Eastern Cape Department of Health procured 100 modified motorbikes to transport patients and community health workers from clinics deep into rural areas where conventional ambulances cannot access. According to The Herald, the Eastern Cape Health Minister, Zweli Mkhize, stated that the National Department of Health was not consulted on the specifications before the procurement of the motorbikes. As a result, the project which was launched by the Eastern Cape Department of Health did not meet the basic criteria for patient transport as an ambulance. Without access to transport, The Herald reported that, in one case, members of the community ended up having to put a patients in a wheelbarrows or walk long distances until they reach a road where ambulances can access. This is an example of how poor communication across provincial and national levels resulted in the procurement of a service and resource that could not be rendered for its purpose. It was stated, however, that despite the inability to transport patients to and from clinics, the motorbikes can be used as transport for community health workers into the community to provide Covid-19 screening and chronic medication delivery. Furthermore, the success and sustainability of such an initiative may inherently rely on the procurement of maintenance and related training that need to be provided, which may be a challenge considering the shortfalls in communication, financial and resource procurement.

In contexts where resources are already limited and health systems are constrained, such as the Sarah Baartman District, it is imperative that measures are taken that effectively respond to the needs of stakeholders on the sharp-end so to protect and facilitate healthcare workers while simultaneously managing the spread of the COVID-19 epidemic.

5.3. Study limitations and future considerations

This study did have some limitations. Firstly, stakeholder perceptions are subjective and although useful in understanding different perspectives, do not provide actual objective inferences around the state of the healthcare system. As opposed to objective data, which should be essential to complimenting subjective data, perception

data provides a wider range of information to help understand the main challenges to consider. According to Stiglitz et al. (2009), objective and subjective indicators could be complimentary rather than alternatives, as they might be measuring different aspects of the same phenomenon, which in the current case, refers to barriers to safe and effective healthcare delivery. Thus, both are still useful, depending on the purposes of measurement. Perception indicators appear useful in identifying gaps and critical points for intervention, an important consideration for HFE application and this study (Meadows, 1999; Wilson, 2014). These perceptions are valuable as they describe the forces that shape attitudes and behaviours of stakeholders around a topic of interest (Lupo et al., 2016) and it is argued that understanding perceptions, specifically related to national level challenges is valuable in contributing *different* information that is both useful and necessary. Future research should consider supplementing perception data with objective measurements, such as incident reports or measurements of processes and outcomes when exploring and understanding perspectives.

Furthermore, in order to gain more comprehensive insight into the perceived barriers to quality care, the perspectives of all stakeholders including patients and their experiences of the healthcare system is necessary. Future research should consider the complexities and perspectives of patients as they offer unique insights and perspectives related to journeys and challenges experienced while navigating health system (Carayon et al., 2020). Additionally, a limitation to the current study was that the perspectives of stakeholders from levels above district management were not possible. As with the perspectives of patients, those of provincial or national level stakeholders may reveal different insights around what limits healthcare delivery in South Africa and a district or provincial level. Future research efforts need to attempt to explore the perceptions held in provincial and national levels of the South African health system, from administration staff to the highest levels of leadership and management.

It is further acknowledged that the exploration of the processes and outcomes was not within the scope of this study. In order to accurately understand how systemic interactions contribute to system processes and outcomes in the Sarah Baartman District, the effects of these barriers on processes and outcomes needs to be explored

in light of the SEIPS model (Carayon et al., 2006; Holden et al., 2013; Carayon et al., 2020). Moreover, higher levels in the health system may echo similar barriers as identified here, but there may also be differences that warrant further investigation. Future research should therefore focus on exploring the perspectives of stakeholders at more provincial and national levels.

A further limitation and one that is an important component to quality improvement, is that of understanding both the barriers *and* the facilitators. The exploration of system *facilitators* is as important as barriers as these may offer areas for improvement or learning, ultimately contributing to improved performance and positive health outcomes. In contexts where resources are scarce and work is constrained by various aspects of the work system, it is important to understand the factors that facilitate safe and effective work, despite system shortcomings. This information can be used to inform the design of training, tasks, environments or procedures. Future research into the South African health system should consider exploring various facilitators to work to understand how, despite the perceived system shortfalls, safe and effective work is enabled (Carayon et al., 2005; Ridelberg et al., 2014).

Chapter 6

Conclusion and Recommendations

This study aimed to explore the barriers to healthcare, with a Human Factors and Ergonomics (HFE) perspective, in South Africa (SA). Although many of the challenges are not new (Coovadia et al., 2009; Managa, 2014; Manyisa and Van Aswege, 2017; Maphumulo and Bhengu, 2019), the current study has provided an opportunity to present and discuss systemic healthcare issues from different perspectives from within the SA health system. Using the Work Systems Model (Smith and Carayon, 1989) as a framework, the findings highlight that within different system components, there are multiple barriers perceived by different stakeholders to limit local performance as well as national healthcare provision in SA.

Firstly, this study highlights that across different workgroups within the Sarah Baartman District, stakeholders perceive common barriers to limit healthcare provision in SA. These common barriers perceived by both sharp-end and blunt-end stakeholders related to a shortage of staff, poor management and leadership, a lack of appropriate training, a lack of resources such as medication, PPE, stationary or cleaning materials, combined with issues of high workloads, patient variability and education, and poorly maintained infrastructure.

Secondly, this study aimed to explore what the various levels of stakeholder, or workgroups, perceive to limit the performance of their own work, in an attempt to understand the unique systemic challenges faced in the Sarah Baartman District. The findings highlight that although common themes were perceived across different levels, the way in which specific barriers were perceived to limit performance, differed across work groups. Most notably, maintenance staff reported on a lack of cleaning materials and equipment and run-down infrastructure while admin staff reported on a lack of stationary or working equipment, and small working areas with limited storage space. CHBC workers reported on issues of job security, a lack of uniform, and transport. Nurses reported on a lack of appropriate training, patient variability, poor hygiene, sanitation, and security in facilities, as well as a lack of specific medical equipment. Pharmacists reported on poor provision of medication, poorly designed facilities and a poor system related to medication ordering and dispensing. Lastly, notable barriers

perceived by management staff related to a lack of resources including stationary and transport (to visit surrounding facilities), as well as poor levels of management and leadership from higher levels of the system.

Using the works systems model and related theory (Smith and Carayon, 1989; Carayon, 2009) to distinguish the interacting system components, the complex and systemic nature of these barriers were elucidated for the first time in the context of the Eastern Cape and specifically, in the Sarah Baartman district health system in South Africa. The findings suggest that barriers experienced in one component, or level of the system, may contribute to barriers in other components or levels in the system. These barriers need to be addressed in order to improve stakeholder's quality of work as well as the quality and safety of the care provided to patients. Achieving this dual objective is key to HFE as described by Dul et al. (2012).

Thirdly, this study aimed to explore various proposed solutions to the barriers perceived as high priority, from the perspectives of the stakeholders within the system. The proposed solutions from the perspective of stakeholders within the Sarah Baartman District, imply that system-wide improvements may be achieved through addressing, at all levels, issues of leadership, staff retention and development, resource procurement and allocation, adequate improvements to physical infrastructure, and the promotion of health literacy in the community. Additionally, participants propose that issues of staffing need to be addressed by either advertising vacancies, absorbing contract workers as permanent staff, and improving on the appropriateness of training. Moreover, participants propose that by building on adequate management, leadership and resource allocation at all levels, the provision of support, the maintenance of facilities, and overall responsiveness to problems could be better addressed. While some of these proposed solutions may seem simple or feasible, it is important to acknowledge that the complexity around achieving them cannot be understated. The complexity around achieving these solutions relates to barriers related to limited financial and leadership capacity that has limited the SA health system (Coovadia et al., 2009; Managa, 2014; Mayeng and Wolvaardt, 2015), together with the abovementioned findings and suggests that the achievement of potential leverage points, or low-cost, no-cost interventions may not be easily attainable without commitment from leadership at all levels of government.

Lastly, this thesis demonstrates the application HFE, and specifically through the application of the Work Systems Model as a theoretical framework (Smith and Carayon, 1989) was useful for guiding, exploring and understanding complex interactions among humans and their work systems in this context. The Work Systems Model is a useful framework used to present these barriers in order to facilitate discussion aimed at guiding future research and improvement efforts from within the Department of Health. Furthermore, some of the barriers highlighted in the current study seem to be more fundamental than those echoed in findings from various contexts (Carayon et al., 2006; Carayon and Gurses, 2008; Ridelberg, 2014; Barker et al., 2017; Hignett et al., 2018; Odberg et al., 2020). For example, the poor state of facilities, job insecurity experienced by many providers, and the lack of essential necessities such as toilet paper, cleaning products or stationary have direct implications on the performance, safety and satisfaction of staff and patients in the Sarah Baartman District. These implications may be due to the combination between SA's unique and deep political, social and economic history together with limited financial and leadership capacity.

Despite the barriers and constraints faced by healthcare stakeholders in South Africa, it is important to recognise and acknowledge the successes that the health system achieves in delivering care to the local population. The focus on barriers and constraints should not necessarily outweigh the ability for stakeholders to continually achieve desirable outcomes during the provision of care (NDoH, 2017). Both the achievements and various aspects that facilitate safe and effective work should not be understated. In consideration of the myriad of barriers and challenges that stakeholders face, emphasis should be placed on the celebrating the successes in order to learn from and replicate them. In an increasingly complex and pressurized system, collaboration, commitment and support from all levels should be afforded to sharp-end providers for the perseverance and resilience they show, despite the risks and consequences they face in attempt to improve on public health. In light of the Department of Health's ultimate mandate, such commitment and support is critical as the provision of high-quality health services is required to ensure the sustainable development and prosperity of public health in SA.

In light of the current findings, the performance and well-being of staff working at the sharp-end may be improved with adequate provision of equipment, resources, maintenance of facilities, and appropriate capacity building of the workforce. Commitment from leaders, especially at the national level, must focus on prioritising resource mobilisation such transport, basic cleaning materials, equipment, or uniform (including PPE) to local districts, so as to facilitate the maintenance of facilities and the satisfaction of staff.

Outlook of recommendations

This study has highlighted issues that future research and improvement efforts should consider, which are outlined below.

At a national level, the Department of Health needs to engage with regulators, companies and governing bodies to accelerate the development and implementation of training programs that take into account the multilingual nature of healthcare workers and focus on continual professional development of all staff at all levels. Additionally, the Department of Health should strategize and implement ways of addressing issues related to job security. Absorption of contract workers, together with continual professional development may build on the long-term capacity and satisfaction of the workforce.

Accountability and transparency is required at all levels and it should be in the National, Provincial and Local Government's best interest to focus on rooting out corruption and developing leadership that advocates decentralisation and strives to improve the safety and effectiveness of healthcare provision in the Sarah Baartman District. Initial efforts within the Sarah Baartman District should involve collaborative efforts to explore the redesign of facilities, the procurement of resources, issues of communication and integration, and the provision of appropriate training in order to attempt to address, or compensate for, constraints that may not be feasible or easily attainable due to constraints faced in provincial and national levels.

Additionally, it is recommended that government prioritise initiatives aimed at addressing community health and education. As proposed by local stakeholders, supplying information through pamphlets or posters that are tailored to the literacy, linguistic and cultural needs of the population and related to the importance of adhering

to and respecting the health system, as well as health and well-being, can be disseminated into various communities to attempt to address the associated challenges related to health literacy.

There is a need for future research to explore and better understand the barriers at different levels, as well as the factors that facilitate safe and effective work. Furthermore, future research should also explore the relationships and interactions among system components, and how these interactions contribute to system processes and outcomes. It is recommended that local health providers from management and various facilities incorporate HFE and other cognate disciplines, to collaboratively explore, identify and address systemic leverage points in an attempt to identify and action system-wide improvements.

Reference list

Abebe, E., & Chui, M. A. (2018). Exploring barriers to medication safety in an Ethiopian hospital emergency department: a human factors engineering approach. INNOVATIONS in pharmacy, 9(1), 7-7.

Adair-Rohani, H., Zukor, K., Bonjour, S., Wilburn, S., Kuesel, A. C., Hebert, R., & Fletcher, E. R. (2013). Limited electricity access in health facilities of sub-Saharan Africa: a systematic review of data on electricity access, sources, and reliability. *Global Health: Science and Practice*, *1*(2), 249-261.

Alegbeleye (2020) Challenges of healthcare delivery in the context of COVID-19 in Sub-Saharan Africa, researchgate.com

Allegranzi, B., Bagheri Nejad, S., Chraiti, M. N., Castillejos, G. G., Kilpatrick, C., & Kelley, E. (2011). Report on the burden of endemic health care-associated infection worldwide. *Geneva, Switzerland: World Health Organization*.

Alper, S. J., & Karsh, B. T. (2009). A systematic review of safety violations in industry. *Accident Analysis & Prevention*, *41*(4), 739-754.

Alper, S. J., Karsh, B. T., Holden, R. J., Scanlon, M. C., Patel, N., & Kaushal, R. (2006, October). Protocol violations during medication administration in pediatrics. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting (Vol. 50, No. 10, pp. 1019-1023). Sage CA: Los Angeles, CA: SAGE Publications

Amalberti, R., Vincent, C., Auroy, Y., & de Saint Maurice, G. (2006). Violations and migrations in health care: a framework for understanding and management. BMJ Quality & Safety, 15(suppl 1), i66-i71.

Appelbaum, S. H., Habashy, S., Malo, J. L., & Shafiq, H. (2012). Back to the future: revisiting Kotter's 1996 change model. *Journal of Management Development*.

Audet, A. M. J., Doty, M. M., Shamasdin, J., & Schoenbaum, S. C. (2005). Measure, learn, and improve: physicians' involvement in quality improvement. *Health Affairs*, *24*(3), 843-853

Badimo, K. H., & Buckley, S. (2014). Improving knowledge management practices in the South African healthcare system. *International Journal of Social,*

Behavioral, Educational, Economic, Business and Industrial Engineering, *8*(11), 3269-3278

Baker, G. R., Norton, P. G., Flintoft, V., Blais, R., Brown, A., Cox, J., ... & O'Beirne, M. (2004). The Canadian Adverse Events Study: the incidence of adverse events among hospital patients in Canada. *Cmaj*, *170*(11), 1678-1686.

Barber, R. M., Fullman, N., Sorensen, R. J., Bollyky, T., McKee, M., Nolte, E., ... & Abd-Allah, F. (2017). Healthcare Access and Quality Index based on mortality from causes amenable to personal health care in 195 countries and territories, 1990–2015: a novel analysis from the Global Burden of Disease Study 2015. *The Lancet*, *390*(10091), 231-266.

Barker, A. K., Brown, K., Siraj, D., Ahsan, M., Sengupta, S., & Safdar, N. (2017). Barriers and facilitators to infection control at a hospital in northern India: a qualitative study. *Antimicrobial Resistance & Infection Control*, *6*(1), 35.

Barker, I., Steventon, A., & Deeny, S. R. (2017). Association between continuity of care in general practice and hospital admissions for ambulatory care sensitive conditions: cross sectional study of routinely collected, person level data. *Bmj*, *356*, j84.

Bar-Yam, Y. (2002). General features of complex systems. *Encyclopedia of Life Support Systems (EOLSS), UNESCO, EOLSS Publishers, Oxford, UK*, *1*.

Bar-Yam, Y. (2019). *Dynamics of complex systems*. CRC Press.

Bass, B. M., & Avolio, B. J. (1994). Transformational leadership and organizational culture. *The International Journal of Public Administration*, *17*(3-4), 541-554.

Basu, S., Andrews, J., Kishore, S., Panjabi, R., & Stuckler, D. (2012). Comparative performance of private and public healthcare systems in low-and middle-income countries: a systematic review. *PLoS medicine*, *9*(6).

Bates, D. W., & Singh, H. (2018). Two decades since to err is human: an assessment of progress and emerging priorities in patient safety. Health Affairs, 37(11), 1736-1743

Bates, D. W., Cullen, D. J., Laird, N., Petersen, L. A., Small, S. D., Servi, D., ... & Vander Vliet, M. (1995). Incidence of adverse drug events and potential adverse drug events: implications for prevention. *Jama*, *274*(1), 29-34.

Battles, J. B., & Stevens, D. P. (2009). Adverse event reporting systems and safer healthcare.

Begun, J. W., Zimmerman, B., & Dooley, K. (2003). Health care organizations as complex adaptive systems. *Advances in health care organization theory*, *253*, 288.

Ben-Tovim, D. I., Dougherty, M. L., O'Connell, T. J., & McGrath, K. M. (2008). Patient journeys: the process of clinical redesign. *Medical Journal of Australia*, *188*(S6), S14-S17.

Berendes, S., Heywood, P., Oliver, S., & Garner, P. (2011). Quality of private and public ambulatory health care in low and middle income countries: systematic review of comparative studies. *PLoS medicine*, *8*(4).

Blecher, M. S., Day, C., Dove, S., & Cairns, R. (2008). Primary Health Care financing in the public sector: Primary Health Care: systems support. *South African health review*, *2008*(1), 179-193.

Bobay, K., Yakusheva, O., & Weiss, M. E. (2011). Outcomes and cost analysis of the impact of unit-level nurse staffing on post-discharge utilization. *Nursing Economics*

Boin, A., Hart, P. T., McConnell, A., Stark, A., Weick, K. E., Sutcliffe, K. M., ... & Harrald, J. R. (1999). VOLUME III.

Boivin, J., Bunting, L., Koert, E., ieng U, C., & Verhaak, C. (2017). Perceived challenges of working in a fertility clinic: a qualitative analysis of work stressors and difficulties working with patients. *Human Reproduction*, *32*(2), 403-408.

Bolden, R. (2011). Distributed leadership in organizations: A review of theory and research. *International Journal of Management Reviews*, *13*(3), 251-269

Bowden, Campanile and Golding, "Worker at NYC hospital where nurses wear trash bags as protection dies from coronavirus," New York Post, March 25, 2020

Bowie, P., & Paterson-Brown, S. (2019). Taking Forward Human Factors and Ergonomics Integration in NHS Scotland: Progress and Challenges. In *International Conference on Healthcare Ergonomics and Patient Safety* (pp. 3-15). Springer, Cham

Braarud, P. Ø. (2001). Subjective task complexity and subjective workload: Criterion validity for complex team tasks. *International Journal of Cognitive Ergonomics*, *5*(3), 261-273.

Bradshaw, D., Dorrington, R. E., & Sitas, F. (1992). The level of mortality in South M ica in 1985-what does it tell us about health?. *SAMJ*, *82*, 237.

Bradshaw, D., Groenewald, P., Laubscher, R., Nannan, N., Nojilana, B., Norman, R., ... & Dorrington, R. (2003). Initial burden of disease estimates for South Africa, 2000. *South African Medical Journal*, *93*(9), 682-688.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative research in psychology, 3(2), 77-101

Bray, R., Gooskens, I., Moses, S., Kahn, L., & Seekings, J. (2011). Growing up in the new South Africa: Childhood and adolescence in post-apartheid Cape Town. University of Cape Town

Brennan, T. A., Leape, L. L., Laird, N. M., Hebert, L., Localio, A. R., Lawthers, A. G., ... & Hiatt, H. H. (1991). Incidence of adverse events and negligence in hospitalized patients: results of the Harvard Medical Practice Study I. *New England journal of medicine*, *324*(6), 370-376a

Brownlee, S., Chalkidou, K., Doust, J., Elshaug, A. G., Glasziou, P., Heath, I., ... & Korenstein, D. (2017). Evidence for overuse of medical services around the world. *The Lancet*, *390*(10090), 156-168.

Buckner, E. B., Anderson, D. J., Garzon, N., Hafsteinsdottir, T. B., Lai, C. K. Y., & Roshan, R. (2014). Perspectives on global nursing leadership: international experiences from the field. International nursing review, 61(4), 463-471.

Buerhaus, P. I., Donelan, K., Ulrich, B. T., Norman, L., & Dittus, R. (2005). Is the shortage of hospital registered nurses getting better or worse? Findings from two recent national surveys of RNs. *Nursing Economics*, *23*(2), 61-71

Carayon, P. (2009). The balance theory and the work system model… Twenty years later. Intl. Journal of Human–Computer Interaction, 25(5), 313-327.

Carayon, P. (2010). Human factors in patient safety as an innovation. *Applied ergonomics*, *41*(5), 657-665

Carayon, P. (Ed.). (2016). *Handbook of human factors and ergonomics in health care and patient safety*. CRC Press.

Carayon, P., & Gurses, A. P. (2008). Nursing workload and patient safety—a human factors engineering perspective

Carayon, P., & Wood, K. E. (2009). Patient safety. *Information Knowledge Systems Management*, *8*(1-4), 23-46

Carayon, P., Bass, E. J., Bellandi, T., Gurses, A. P., Hallbeck, M. S., & Mollo, V. (2011). Sociotechnical systems analysis in health care: a research agenda. *IIE transactions on healthcare systems engineering*, *1*(3), 145-160.

Carayon, P., Gurses, A. P., Holden, R. J., King, B., Perry, S., Waterson, P., & Wetterneck, T. (2014, September). Macroergonomics in healthcare: past, present and future of the SEIPS (Systems Engineering Initiative for Patient Safety) approach. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting (Vol. 58, No. 1, pp. 1541-1545). Sage CA: Los Angeles, CA: SAGE Publications.

Carayon, P., & Gürses, A. P. (2005). A human factors engineering conceptual framework of nursing workload and patient safety in intensive care units. Intensive and Critical Care Nursing, 21(5), 284-301.

Carayon, P., Hancock, P., Leveson, N., Noy, I., Sznelwar, L., & Van Hootegem, G. (2015). Advancing a sociotechnical systems approach to workplace safety–developing the conceptual framework. *Ergonomics*, *58*(4), 548-564.

Carayon, P., Hundt, A. S., Karsh, B. T., Gurses, A. P., Alvarado, C. J., Smith, M., & Brennan, P. F. (2006). Work system design for patient safety: the SEIPS model. *BMJ Quality & Safety*, *15*(suppl 1), i50-i58

Carayon, P., Kianfar, S., Li, Y., Xie, A., Alyousef, B., & Wooldridge, A. (2015). A systematic review of mixed methods research on human factors and ergonomics in health care. *Applied ergonomics*, *51*, 291-321.

Carayon, P., Wetterneck, T. B., Rivera-Rodriguez, A. J., Hundt, A. S., Hoonakker, P., Holden, R., & Gurses, A. P. (2014). Human factors systems approach to healthcare quality and patient safety. Applied ergonomics, 45(1), 14-25

Carayon, P., Wooldridge, A., Hose, B. Z., Salwei, M., & Benneyan, J. (2018). Challenges and opportunities for improving patient safety through human factors and systems engineering. Health Affairs, 37(11), 1862-1869

Carayon, P., Xie, A. (2014). Human factors and ergonomics as a patient safety practice. BMJ Quality & Safety, 23(3), 196-205

Card, A. J., Ward, J. R., & Clarkson, P. J. (2014). Generating Options for Active Risk Control (GO-ARC): Introducing a Novel Technique. *Journal for Healthcare Quality*, *36*(5), 32-41

Catchpole, K. (2013). Toward the modelling of safety violations in healthcare systems. BMJ quality & safety, 22(9), 705-709.

Catchpole, K., & Jeffcott, S. (2016). 13 Human Factors and Ergonomics Practice in Healthcare. *Human Factors and Ergonomics in Practice: Improving System Performance and Human Well-Being in the Real World*, 181.

Chan, A. J., Islam, M. K., Rosewall, T., Jaffray, D. A., Easty, A. C., & Cafazzo, J. A. (2010). The use of human factors methods to identify and mitigate safety issues in radiation therapy. Radiotherapy and Oncology, 97(3), 596-600

Chapanis, A., & Safrin, M. A. (1960). Of misses and medicines. *Journal of chronic diseases*, *12*(4), 403-408.

Chattopadhyay, S. (2013). Corruption in healthcare and medicine: why should physicians and bioethicists care and what should they do. Indian J Med Ethics, 10(3), 153-9

Chawla, S., Kurani, S., Wren, S. M., Stewart, B., Burnham, G., Kushner, A., & McIntyre, T. (2018). Electricity and generator availability in LMIC hospitals: improving access to safe surgery. *Journal of Surgical Research*, *223*, 136-141.

Cheng, L., Feng, S., Hu, Y., & Broome, M. E. (2018). Leadership practices of nurse managers for implementing evidence-based nursing in China. Journal of nursing management, 26(6), 671-678.

Chopra, M., Daviaud, E., Pattinson, R., Fonn, S., & Lawn, J. E. (2009). Saving the lives of South Africa's mothers, babies, and children: can the health system deliver?. *The Lancet*, *374*(9692), 835-846.

Chui, M. A., Mott, D. A., & Maxwell, L. (2012). A qualitative assessment of a community pharmacy cognitive pharmaceutical services program, using a work system approach. *Research in Social and Administrative Pharmacy*, *8*(3), 206-216.

Cilliers, P. (2002). Why we cannot know complex things completely. Emergence, 4(1-2), 77-84.

Cilliers, P., & Spurrett, D. (1999). Complexity and post-modernism: Understanding complex systems. *South African Journal of Philosophy*, *18*(2), 258-274.

Clegg, C. W. (2000). Sociotechnical principles for system design. *Applied ergonomics*, *31*(5), 463-477.

Cohen, M. M., Eustis, M. A., & Gribbins, R. E. (2003). Changing the culture of patient safety: leadership's role in health care quality improvement. The Joint Commission Journal on Quality and Safety, 29(7), 329-335.

Cong, X., Li-Hua, R., & Stonehouse, G. (2007). Knowledge management in the Chinese public sector: empirical investigation. *Journal of Technology Management in China*.

Cook, R., & Rasmussen, J. (2005). "Going solid": a model of system dynamics and consequences for patient safety. *BMJ Quality & Safety*, *14*(2), 130-134.

Cooper, J. B., Gaba, D. M., Liang, B., Woods, D., & Blum, L. N. (2000). The National Patient Safety Foundation agenda for research and development in patient safety. MedGenMed: Medscape general medicine, 2(3), E3

Coovadia, H., Jewkes, R., Baron, P., Sanders, D. & McIntyre, D., 2009, 'The health and health system of South Africa: Historical roots of current public health challenges', *Lancet* 374, 817-834. PMID: 19709728

Corrigan, J. M. (2005). Crossing the quality chasm. Building a better delivery system

Cracknell, A., Lovatt, A., Winfield, A., Arkhipkina, S., McDonagh, E., Green, A., & Rooney, M. (2016). Huddle up for safer healthcare: how frontline teams can work together to improve patient safety. *Future hospital journal*, *3*(Suppl 2)

Cresswell, K., Howe, A., Steven, A., Smith, P., Ashcroft, D., Fairhurst, K., ... & Sheikh, A. (2013). Patient safety in healthcare preregistration educational curricula: multiple case study-based investigations of eight medicine, nursing, pharmacy and physiotherapy university courses. *BMJ Qual Saf*, *22*(10), 843-854

Cronk, R., & Bartram, J. (2018). Environmental conditions in health care facilities in low-and middle-income countries: coverage and inequalities. *International journal of hygiene and environmental health*, *221*(3), 409-422.

Currie, G., & Lockett, A. (2011). Distributing leadership in health and social care: concertive, conjoint or collective?. *International Journal of Management Reviews*, *13*(3), 286-300

Currie, G., Lockett, A., & Suhomlinova, O. (2009). Institutional limitations on distributed leadership in complex organizations: a ‘catch 22’in English public services. *Human Relations*, *60*(2), 341-370

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of management journal*, *34*(3), 555-590.

Daniels, K., Hanefeld, J., & Marchal, B. (2017). Social sciences: vital to improving our understanding of health equity, policy and systems. International journal for equity in health, 16(1), 1-3

Das, J., & Leino, J. (2011). Evaluating the RSBY: lessons from an experimental information campaign. *Economic and Political Weekly*, 85-93.

Davis Giardina, T., King, B. J., Ignaczak, A. P., Paull, D. E., Hoeksema, L., Mills, P. D., ... & Singh, H. (2013). Root cause analysis reports help identify common factors in delayed diagnosis and treatment of outpatients. Health Affairs, 32(8), 1368-1375

Davis, P., Lay-Yee, R., Briant, R., Ali, W., Scott, A., & Schug, S. (2002). Adverse events in New Zealand public hospitals I: occurrence and impact. *The New Zealand Medical Journal (Online)*, *115*(1167).

Day, C., & Gray, A. (2007). Health and related indicators. *South African health review*, *2007*(1), 213-344.

De Savigny, D., & Adam, T. (Eds.). (2009). *Systems thinking for health systems strengthening*. World Health Organization.

de Vries, E. N., Ramrattan, M. A., Smorenburg, S. M., Gouma, D. J., & Boermeester, M. A. (2008). The incidence and nature of in-hospital adverse events: a systematic review. *BMJ Quality & Safety*, *17*(3), 216-223

Dekker, S. (2016). *Drift into failure: From hunting broken components to understanding complex systems*. CRC Press.

Dekker, S. W. (2013). Drifting into failure: Complexity theory and the management of risk. In *Chaos and complexity theory for management: Nonlinear dynamics* (pp. 241-253). IGI Global.

Dekker, S. W., & Lundstrom, J. (2006). From threat and error management (TEM) to resilience. *Human Factors and Aerospace Safety*, *6*(3), 261.

Dekker, S. W., Hancock, P. A., & Wilkin, P. (2013). Ergonomics and sustainability: towards an embrace of complexity and emergence. *Ergonomics*, *56*(3), 357-364.

Dekker, S., Cilliers, P., & Hofmeyr, J. H. (2011). The complexity of failure: implications of complexity theory for safety investigations. *Safety science*, *49*(6), 939-945

DeMeyer, A. C. L., Loch, C. H., & Pich, M. T. (2002). Managing project uncertainty: from variation to chaos. *MIT Sloan Management Review*, *43*(2), 60

Department of Health (2019), Annual Report; https://pmg.org.za/committee-meeting/29258/

Department of Health, South Africa, Annual report (2017)

Department of Health. (2003). National health Act, 203 National health Insurance policy, towards universal health coverage

Devitt, N., & Murphy, J. (2004). A survey of the information management and technology training needs of doctors in an acute NHS trust in the United Kingdom. *Health Information & Libraries Journal*, *21*(3), 164-172

Dewar, R., & Hage, J. (1978). Size, technology, complexity, and structural differentiation: Toward a theoretical synthesis. *Administrative Science Quarterly*, 111-136.

Dixon-Woods, M. (2019). How to improve healthcare improvement—an essay by Mary Dixon-Woods. *bmj*, *367*

Dixon-Woods, M., Baker, R., Charles, K., Dawson, J., Jerzembek, G., Martin, G., ... & Willars, J. (2014). Culture and behaviour in the English National Health Service: overview of lessons from a large multimethod study. *BMJ Qual Saf*, *23*(2), 106-115.

Donabedian, A. (1966). Evaluating the quality of medical care. *The Milbank memorial fund quarterly*, *44*(3), 166-206.

Donaldson, M. S., Corrigan, J. M., & Kohn, L. T. (Eds.). (2000). To err is human: building a safer health system (Vol. 6). National Academies Press.

Dowling, P. (2011). Healthcare supply chains in developing countries: situational analysis. *Arlington, Va.: USAID| DELIVER PROJECT*.

Dul, J., Bruder, R., Buckle, P., Carayon, P., Falzon, P., Marras, W. S., ... & van der Doelen, B. (2012). A strategy for human factors/ergonomics: developing the discipline and profession. *Ergonomics*, *55*(4), 377-395

Eastern Cape Department of Health (ECDoH), (2017). URL: http://www.echealth.gov.za/

Eastern Cape Government (ECGov), (2017). URL: http://www.ecprov.gov.za

Edwards, K., & Jensen, P. L. (2014). Design of systems for productivity and well being. *Applied Ergonomics*, *45*(1), 26-32.

Edwards, N., & Barker, P. M. (2014). The importance of context in implementation research. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, *67*, S157-S162

Ellinas, C., Allan, N., & Johansson, A. (2017). Dynamics of organizational culture: Individual beliefs vs. social conformity. *PloS one*, *12*(6)

Etoori, D., Wringe, A., Renju, J., Kabudula, C. W., Gomez-Olive, F. X., & Reniers, G. (2020). Challenges with tracing patients on antiretroviral therapy who are late for clinic appointments in rural South Africa and recommendations for future practice. *Global Health Action*, *13*(1), 1755115

Evans, S. M., Berry, J. G., Smith, B. J., Esterman, A., Selim, P., O'Shaughnessy, J., & DeWit, M. (2006). Attitudes and barriers to incident reporting: a collaborative hospital study. BMJ Quality & Safety, 15(1), 39-43.

Evenson, S., Muller, M., & Roth, E. M. (2008). Capturing the context of use to inform system design. *Journal of cognitive engineering and decision making*, *2*(3), 181-203

Eygelaar, J. E., & Stellenberg, E. L. (2012). Barriers to quality patient care in rural district hospitals. *curationis*, *35*(1), 1-8.

Farley, D. O., Haviland, A., Champagne, S., Jain, A. K., Battles, J. B., Munier, W. B., & Loeb, J. M. (2008). Adverse-event-reporting practices by US hospitals: results of a national survey. BMJ Quality & Safety, 17(6), 416-423.

Fewster-Thuente, L., & Velsor-Friedrich, B. (2008). Interdisciplinary collaboration for healthcare professionals. *Nursing administration quarterly*, *32*(1), 40-48.

Fiscella, K. (2004). Socioeconomic status disparities in healthcare outcomes: selection bias or biased treatment?. *Medical care*, *42*(10), 939-942.

Fiscella, K., Franks, P., & Clancy, C. M. (1998). Skepticism toward medical care and health care utilization. *Medical care*, 180-189

Fiscella, K., Franks, P., Doescher, M. P., & Saver, B. G. (2002). Disparities in health care by race, ethnicity, and language among the insured: findings from a national sample. *Medical care*, 52-59.

Fiscella, K., Franks, P., Gold, M. R., & Clancy, C. M. (2000). Inequality in quality: addressing socioeconomic, racial, and ethnic disparities in health care. *Jama*, *283*(19), 2579-2584

Flach, J. M., Dekker, S., & Jan Stappers, P. (2008). Playing twenty questions with nature (the surprise version): Reflections on the dynamics of experience. *Theoretical Issues in Ergonomics Science*, *9*(2), 125-154

Folke, C. (2006). Resilience: The emergence of a perspective for social–ecological systems analyses. Global environmental change, 16(3), 253-267

Forster, A. J., Asmis, T. R., Clark, H. D., Al Saied, G., Code, C. C., Caughey, S. C., ... & van Walraven, C. (2004). Ottawa Hospital Patient Safety Study: incidence and timing of adverse events in patients admitted to a Canadian teaching hospital. *Cmaj*, *170*(8), 1235-1240

Friedman, T. L. (2005). *The world is flat: A brief history of the twenty-first century*. Macmillan.

Ganesan, S., Magee, M., Stone, J. E., Mulhall, M. D., Collins, A., Howard, M. E., ... & Sletten, T. L. (2019). The impact of shift work on sleep, alertness and performance in healthcare workers. *Scientific reports*, *9*(1), 1-13.

Gibson, M. L., Hohmeier, K. C., & Smith, C. T. (2017). Pharmacogenomics testing in a community pharmacy: patient perceptions and willingness-to-pay. *Pharmacogenomics*, *18*(3), 227-233.

Gibson, T. D., Pelling, M., Ghosh, A., Matyas, D., Siddiqi, A., Solecki, W., ... & Du Plessis, R. (2016). Pathways for transformation: Disaster risk management to enhance resilience to extreme events. *Journal of Extreme Events*, *3*(01), 1671002.

Gilson, L., & Daire, J. (2011). Leadership and governance within the South African health system. *South African health review*, *2011*(1), 69-80

Gosbee, J. (2002). Human factors engineering and patient safety. *Qual Saf Health Care*, *11*(4), 352-354.

Goudge, J., Gilson, L., Russell, S., Gumede, T., & Mills, A. (2009). Affordability, availability and acceptability barriers to health care for the chronically ill: longitudinal case studies from South Africa. *BMC health services research*, *9*(1), 75.

Greenfield, S., Kaplan, S. H., Ware, J. E., Yano, E. M., & Frank, H. J. (1988). Patients' participation in medical care. *Journal of general internal medicine*, *3*(5), 448-457

Greenfield, S., Kaplan, S., & Ware Jr, J. E. (1985). Expanding patient involvement in care: effects on patient outcomes. *Annals of internal medicine*, *102*(4), 520-528

Greenglass, E. R., Burke, R. J., & Moore, K. A. (2003). Reactions to increased workload: Effects on professional efficacy of nurses. *Applied psychology*, *52*(4), 580-597.

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: systematic review and recommendations. *The Milbank Quarterly*, *82*(4), 581-629.

Grint, K. (2008). *Wicked problems and clumsy solutions: the role of leadership*

Grober, E. D., & Bohnen, J. M. (2005). Defining medical error. canadian Journal of Surgery, 48(1), 39

Gronn, P. (2002). Distributed leadership. In *Second international handbook of educational leadership and administration* (pp. 653-696). Springer, Dordrecht.

Grote, G., Ryser, C., WĀLER, T., Windischer, A., & Weik, S. (2000). KOMPASS: A method for complementary function allocation in automated work systems. *International Journal of Human-Computer Studies*, *52*(2), 267-287.

Gurses, A. P., & Carayon, P. (2007). Performance obstacles of intensive care nurses. *Nursing research*, *56*(3), 185-194.

Gurses, A. P., Carayon, P., & Wall, M. (2009). Impact of performance obstacles on intensive care nurses' workload, perceived quality and safety of care, and quality of working life. *Health services research*, *44*(2p1), 422-443.

Gurses, A. P., Marsteller, J. A., Ozok, A. A., Xiao, Y., Owens, S., & Pronovost, P. J. (2010). Using an interdisciplinary approach to identify factors that affect clinicians' compliance with evidence-based guidelines. *Critical care medicine*, *38*, S282-S291.

Gurses, A. P., Martinez, E. A., Bauer, L., Kim, G., Lubomski, L. H., Marsteller, J. A., ... & Thompson, D. (2012). Using human factors engineering to improve patient safety in the cardiovascular operating room. *Work*, *41*(Supplement 1), 1801-1804.

Habibov, N. (2016). Effect of corruption on healthcare satisfaction in post-soviet nations: A cross-country instrumental variable analysis of twelve countries. Social Science & Medicine, 152, 119-124

Hackman, J. R. (2003). Learning more by crossing levels: Evidence from airplanes, hospitals, and orchestras. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *24*(8), 905-922.

Haines, H., Wilson, J. R., Vink, P., & Koningsveld, E. (2002). Validating a framework for participatory ergonomics (the PEF). *Ergonomics*, *45*(4), 309-327

Halbesleben, J. R., Wakefield, B. J., Wakefield, D. S., & Cooper, L. B. (2008). Nurse burnout and patient safety outcomes: nurse safety perception versus reporting behavior. Western journal of nursing research, 30(5), 560-577

Hale, A., & Heijer, T. (2006). Is Resilience Really Necessary? The Case of Railways. Hollnagel E, Woods D, Leveson N, editors. Resilience Engineering: Concepts and Precepts.

Halligan, M., & Zecevic, A. (2011). Safety culture in healthcare: a review of concepts, dimensions, measures and progress. BMJ quality & safety, 20(4), 338-343

Hanefeld, J., Mayhew, S., Legido-Quigley, H., Martineau, F., Karanikolos, M., Blanchet, K., ... & Balabanova, D. (2018). Towards an understanding of

resilience: responding to health systems shocks. *Health policy and planning*, *33*(3), 355-367.

Haroon, M. Z. (2014). Corruption in healthcare system: an obstacle in achieving optimal outcome. Journal of Ayub Medical College Abbottabad, 26(2), 109-110.

Hasvold, P. E., & Scholl, J. (2011). Flexibility in interaction: sociotechnical design of an operating room scheduler. International Journal of Medical Informatics, 80(9), 631-645.

Health Quality Ontario. (2017). Patient safety learning systems: a systematic review and qualitative synthesis. *Ontario health technology assessment series*, *17*(3), 1

Helander M. (2006). A Guide to Human Factors and Ergonomics. 2nd ed. Boca Raton, FL: Taylor & Francis.

Hellerawa, K. S. S. M., & Adambarage, D. C. (2015). The nursing shortage impact on job outcome (The case in Sri Lanka). *Journal of Competitiveness*, *7*(3), 75-94.

Helmreich, R. L., Wilhelm, J. A., Klinect, J. R., & Merritt, A. C. (2001). Culture, error and crew resource management. *Improving teamwork in organizations: Applications of resource management training*, *305331*.

Hendrick, H. W. (1991). Ergonomics in organizational design and management. *Ergonomics*, *34*(6), 743-756.

Hendrick, H. W., & Kleiner, B. M. (2002). *Macroergonomics: Theory, methods, and applications*. Lawrence Erlbaum Associates Publishers.

Hernandez-Boussard, T., McDonald, K. M., Morton, J. M., Dalman, R. L., & Bech, F. R. (2012). Determinants of adverse events in vascular surgery. *Journal of the American College of Surgeons*, *214*(5), 788-797.

Hettinger, L. J., Kirlik, A., Goh, Y. M., & Buckle, P. (2015). Modelling and simulation of complex sociotechnical systems: envisioning and analysing work environments. *Ergonomics*, *58*(4), 600-614.

Heunis, J. C., & Van Rensburg, H. C. J. (2006). Assessmenf othe implementation of the primayy health care package atselected sites in South Africa. *Curationis*.

Hignett, S. (2003). Hospital ergonomics: a qualitative study to explore the organizational and cultural factors. *Ergonomics*, *46*(9), 882-903.

Hignett, S., Carayon, P., Buckle, P., & Catchpole, K. (2013). State of science: human factors and ergonomics in healthcare. *Ergonomics*, *56*(10), 1491-1503.

Hignett, S., Jones, E. L., Miller, D., Wolf, L., Modi, C., Shahzad, M. W., ... & Catchpole, K. (2015). Human factors and ergonomics and quality improvement science: integrating approaches for safety in healthcare. *BMJ Qual Saf*, *24*(4), 250-254.

Hignett, S., Lang, A., Pickup, L., Ives, C., Fray, M., McKeown, C., ... & Bowie, P. (2018). More holes than cheese. What prevents the delivery of effective, high quality and safe health care in England?. *Ergonomics*, *61*(1), 5-14

Hoben, M., Kent, A., Kobagi, N., & Yoon, M. N. (2016). Effective strategies to motivate nursing home residents in oral healthcare and to prevent or reduce responsive behaviours to oral healthcare: a systematic review protocol. BMJ open, 6(3)

Holden, R. J. (2011). What stands in the way of technology-mediated patient safety improvements? A study of facilitators and barriers to physicians' use of electronic health records. *Journal of patient safety*, *7*(4), 193.

Holden, R. J., & Karsh, B. T. (2009). A theoretical model of health information technology usage behaviour with implications for patient safety. *Behaviour & Information Technology*, *28*(1), 21-38.

Holden, R. J., Carayon, P., Gurses, A. P., Hoonakker, P., Hundt, A. S., Ozok, A. A., & Rivera-Rodriguez, A. J. (2013). SEIPS 2.0: a human factors framework for studying and improving the work of healthcare professionals and patients. *Ergonomics*, *56*(11), 1669-1686.

Holden, R. J., Scanlon, M. C., Patel, N. R., Kaushal, R., Escoto, K. H., Brown, R. L., ... & Karsh, B. T. (2011). A human factors framework and study of the effect of nursing workload on patient safety and employee quality of working life. *BMJ quality & safety*, *20*(1), 15-24

Hollnagel, E. (2016). The nitty-gritty of human factors. *Human Factors and Ergonomics in Practice: Improving System Performance and Human Well-Being in the Real World*, 45-64

Hollnagel, E. (2017). *Safety-II in practice: developing the resilience potentials*. Taylor & Francis.

Hollnagel, E., Wears, R. L., & Braithwaite, J. (2015). From Safety-I to Safety-II: a white paper. *The resilient health care net: published simultaneously by the University of Southern Denmark, University of Florida, USA, and Macquarie University, Australia*.

Hollnagel, E., Woods, D. D., & Leveson, N. (Eds.). (2006). *Resilience engineering: Concepts and precepts*. Ashgate Publishing, Ltd..

Hoonakker, P. L., Carayon, P., McGuire, K., Khunlertkit, A., Wiegmann, D. A., Alyousef, B., ... & Wood, K. E. (2013). Motivation and job satisfaction of Tele-ICU nurses. *Journal of Critical Care*, *28*(3), 315-e13.

Hornberger, J. (2001). Introduction to Bayesian reasoning. *International journal of technology assessment in health care*, *17*(1), 9-16.

Horwitz, R. I., & Horwitz, S. M. (1993). Adherence to treatment and health outcomes. *Archives of internal medicine*, *153*(16), 1863-1868

Howitt, P., Darzi, A., Yang, G. Z., Ashrafian, H., Atun, R., Barlow, J., ... & Cooke, G. S. (2012). Technologies for global health. *The Lancet*, *380*(9840), 507-535.

Hu, J. S., Wen-Hui, Y., & Chou, Y. Y. (2006). Classifying healthcare network relationships: An analysis with recommendations for managers. *International Journal of Management*, *23*(3), 665.

Hu, Y. C. (2009, September). Research on relationship of knowledge management and organizational performance. In *2009 International Conference on Management of e-Commerce and e-Government* (pp. 281-283). IEEE

Hughes, P. (1990). Evaluating the impact of continual professional education (ENB 941). *Nurse education today*, *10*(6), 428-436.

Hugonnet, S., Chevrolet, J. C., & Pittet, D. (2007). The effect of workload on infection risk in critically ill patients. *Critical care medicine*, *35*(1), 76-81

Hwang, W., Chang, J., LaClair, M., & Paz, H. (2013). Effects of integrated delivery system on cost and quality. Am J Manag Care, 19(5), e175-e184.

Hysong, S. J., Sawhney, M. K., Wilson, L., Sittig, D. F., Esquivel, A., Watford, M., ... & Singh, H. (2009). Improving outpatient safety through effective electronic communication: a study protocol. *Implementation Science*, *4*(1), 62.

Ijumba, P. (2002). 'Voices' of primary health care facility workers: human resources. *South African health review*, *2002*(1), 181-200

Institute of Medicine: Smith, C. (2004). New technology continues to invade healthcare: What are the strategic implications/outcomes?. *Nursing Administration Quarterly*, *28*(2), 92-98.

Institute of Medicine. (2001). *Crossing the quality chasm: A new health System for the 21st century,* National Academic Press, Washington, DC

Jha, A. K., Larizgoitia, I., Audera-Lopez, C., Prasopa-Plaizier, N., Waters, H., & Bates, D. W. (2013). The global burden of unsafe medical care: analytic modelling of observational studies. *BMJ Qual Saf*, *22*(10), 809-815.

Ji, Y., Ma, Z., Peppelenbosch, M. P., & Pan, Q. (2020). Potential association between COVID-19 mortality and health-care resource availability. *The Lancet Global Health*, *8*(4), e480.

Johnson, B. R. (2010). Eliminating the mystery from the concept of emergence. *Biology & philosophy*, *25*(5), 843-849.

Johnson, C. M., Johnson, T. R., & Zhang, J. (2005). A user-centered framework for redesigning health care interfaces. Journal of biomedical informatics, 38(1), 75-87.

Johnson, C. W. (2006). What are emergent properties and how do they affect the engineering of complex systems?. *Reliability Engineering and System Safety*, *91*(12), 1475-1481

Jones, C. (2018). Patient safety:# theatrecapchallenge goes viral. ANZCA Bulletin, 26(1), 28.

Kale, E., & Kumar, B. N. (2012). Challenges in healthcare in multi-ethnic societies:

communication as a barrier to achieving health equity. *Public Health–Social and Behavioral Health*, 295

Karim, S. S. A., Churchyard, G. J., Karim, Q. A., & Lawn, S. D. (2009). HIV infection and tuberculosis in South Africa: an urgent need to escalate the public health response. *the Lancet*, *374*(9693), 921-933.

Karsh, B. T. (2004). Beyond usability: designing effective technology implementation systems to promote patient safety. *BMJ Quality & Safety*, *13*(5), 388-394

Karsh, B. T., & Alper, S. J. (2005). Work system analysis: the key to understanding health care systems. *Advances in patient safety: from research to implementation*, *2*, 337-348.

Karsh, B. T., Escoto, K. H., Beasley, J. W., & Holden, R. J. (2006). Toward a theoretical approach to medical error reporting system research and design. *Applied ergonomics*, *37*(3), 283-295.

Karsh, B. T., Waterson, P., & Holden, R. J. (2014). Crossing levels in systems ergonomics: a framework to support 'mesoergonomic'inquiry. Applied ergonomics, 45(1), 45-54.

Karsh, B., & Brown, R. (2005). The impact of organizational hierarchies on the design and analysis of medical error research. *Proceedings of Human Factors in Organizational Design and Management–VIII*, 293-8.

Karsh, B., & Brown, R. (2009). Macroergonomics and patient safety: The impact of levels on theory, measurement, analysis and intervention in medical error research. *Applied Ergonomics*.

Karwowski, W. (1991). Complexity, fuzziness, and ergonomic incompatibility issues in the control of dynamic work environments. *Ergonomics*, *34*(6), 671-686.

Karwowski, W. (2012). A review of human factors challenges of complex adaptive systems: discovering and understanding chaos in human performance. *Human factors*, *54*(6), 983-995.

Karwowski, W. (Ed.). (2006). International Encyclopedia of Ergonomics and Human Factors-3 Volume Set. CRC Press.

Katz-Navon, T. A. L., Naveh, E., & Stern, Z. (2005). Safety climate in health care organizations: A multidimensional approach. Academy of Management Journal, 48(6), 1075-1089

Kenzie, M., Safdar, N., Abdissa, A., Yilma, D., & Siraj, D. (2018, November). 454. Barriers and Facilitators to Control of Hospital Acquired Infections in Jimma, Ethiopia. In Open Forum Infectious Diseases (Vol. 5, No. Suppl 1, p. S171). Oxford University Press.

Khan, S., Vandermorris, A., Shepherd, J., Begun, J. W., Lanham, H. J., Uhl-Bien, M., & Berta, W. (2018). Embracing uncertainty, managing complexity: applying complexity thinking principles to transformation efforts in healthcare systems. *BMC health services research*, *18*(1), 192.

Kigen, G. K., Ronoh, H. K., Kipkore, W. K., & Rotich, J. K. (2013). Current trends of traditional herbal medicine practice in Kenya: a review. *African Journal of Pharmacology and Therapeutics*, *2*(1).

Kim, Y. M., Newby-Bennett, D., & Song, H. J. (2012). Knowledge sharing and institutionalism in the healthcare industry. *Journal of Knowledge Management*

Kindig, D. A., Panzer, A. M., & Nielsen-Bohlman, L. (Eds.). (2004). *Health literacy: a prescription to end confusion*. National Academies Press

Kleiner, B. M. (2006). Macroergonomics: analysis and design of work systems. *Applied ergonomics*, *37*(1), 81-89.

Kleiner, B. M. (2008). Macroergonomics: work system analysis and design. Human factors, 50(3), 461-467.

Kleiner, B. M., & Hendrick, H. W. (2008). Human factors in organizational design and management of industrial plants. *International Journal of Technology and Human Interaction (IJTHI)*, *4*(1), 113-127.

Klopper, H. C., Rabie, T., & Coetzee, S. K. (2016). The nature of community health care centre practice environments in a province in South Africa. *Africa Journal of Nursing and Midwifery*, *18*(2), 27-41.

Kohn, L. T., Corrigan, J. M., & Doyle, D. J. (2001). To err is human: building a safer health system. *Canadian Medical Association. Journal*, *164*(4), 527

Krieger, N. (1992). Overcoming the absence of socioeconomic data in medical records: validation and application of a census-based methodology. *American journal of public health*, *82*(5), 703-71

Kripalani, S., LeFevre, F., Phillips, C. O., Williams, M. V., Basaviah, P., & Baker, D. W. (2007). Deficits in communication and information transfer between hospital-based and primary care physicians: implications for patient safety and continuity of care. *Jama*, *297*(8), 831-841.

Kukreja, B.J., Dodwad, V. & Kukreja, P., 2012, 'The law and medical negligence – An overview', International Journal of Public Health and Dentistry 3, 11–19

La Porte, T. R. (1996). High reliability organizations: Unlikely, demanding and at risk. *Journal of contingencies and crisis management*, *4*(2), 60-71.

Landrigan, C. P., Rothschild, J. M., Cronin, J. W., Kaushal, R., Burdick, E., Katz, J. T., ... & Czeisler, C. A. (2004). Effect of reducing interns' work hours on serious medical errors in intensive care units. *New England Journal of Medicine*, *351*(18), 1838-1848

Lannin, D. R., Mathews, H. F., Mitchell, J., Swanson, M. S., Swanson, F. H., & Edwards, M. S. (1998). Influence of socioeconomic and cultural factors on racial differences in late-stage presentation of breast cancer. *Jama*, *279*(22), 1801-1807

Larsen-Freeman, D. (2010). Having and doing: Learning from a complexity theory perspective. In Conceptualising 'learning'in applied linguistics (pp. 52-68). Palgrave Macmillan, London.

Lawton, R. (1998). Not working to rule: understanding procedural violations at work. Safety science, 28(2), 77-95.

Leape, L. L. (1997). A systems analysis approach to medical error. *Journal of evaluation in clinical practice*, *3*(3), 213-222.

Leape, L. L., Brennan, T. A., Laird, N., Lawthers, A. G., Localio, A. R., Barnes, B. A., ... & Hiatt, H. (1991). The nature of adverse events in hospitalized patients: results of the Harvard Medical Practice Study II. New England journal of medicine, 324(6), 377-384

Lee, S. E., Scott, L. D., Dahinten, V. S., Vincent, C., Lopez, K. D., & Park, C. G. (2019). Safety culture, patient safety, and quality of care outcomes: A literature review. Western journal of nursing research, 41(2), 279-304 Feng, X. Q., Acord, L., Cheng, Y. J., Zeng, J. H., & Song, J. P. (2011). The relationship between management safety commitment and patient safety culture. International nursing review, 58(2), 249-254

Leon, N., Bhunu, F., & Kenyon, C. (2001). Voices of facility managers. *South African Health Review*, *2001*(1), 207-220

Leplat, J. (1989). Relations between task and activity in training. Developing Skills with Information Technology, John Wiley & Sons, Chichester.

Lesselroth, B. J., Adams, K., Tallett, S., Wood, S. D., Keeling, A., Cheng, K., ... & Tran, H. (2013). Design of admission medication reconciliation technology: a human factors approach to requirements and prototyping. HERD: Health Environments Research & Design Journal, 6(3), 30-48

Leveson, N. (2004). A new accident model for engineering safer systems. *Safety science*, *42*(4), 237-270

Liese B, Dussault G. The State of the Health Workforce in Sub-Saharan Africa: Evidence of Crisis and Analysis of Contributing Factors. Africa Region Human Development Working Paper Series. Washington, DC: World Bank, 2004.

Lin, L., Isla, R., Doniz, K., Harkness, H., Vicente, K. J., & Doyle, D. J. (1998). Applying human factors to the design of medical equipment: patient-controlled analgesia. Journal of clinical monitoring and computing, 14(4), 253-263

Lindroos, O. (2009). Relationships between observed and perceived deviations from normative work procedures. Ergonomics, 52(12), 1487-1500.

Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease. *Journal of health and social behavior*, 80-94

Lipsitz, L. A. (2012). Understanding health care as a complex system: the foundation for unintended consequences. *Jama*, *308*(3), 243-244.

Lupo, C., Wilmart, O., Van Huffel, X., Dal Pozzo, F., & Saegerman, C. (2016). Stakeholders' perceptions, attitudes and practices towards risk prevention in the food chain. *Food Control*, *66*, 158-165

Lwears, R. (2012). Rethinking healthcare as a safety-critical industry. *Work*, *41*(Supplement 1), 4560-4563

Machta, R. M., Maurer, K. A., Jones, D. J., Furukawa, M. F., & Rich, E. C. (2019). A systematic review of vertical integration and quality of care, efficiency, and patient-centered outcomes. Health care management review, 44(2), 159-173.

Magnussen, J., Vrangbaek, K., & Saltman, R. (2009). *Nordic Health Care Systems: Recent Reforms And Current Policy Challenges: Recent Reforms and Current Policy Challenges*. McGraw-Hill Education (UK).

Makary, M. A., & Daniel, M. (2016). Medical error—the third leading cause of death in the US. *Bmj*, *353*.

Managa, A., (2014), Unfulfilled promises and their consequences: A reflection on local government performance and the critical issue of poor service delivery in South Africa, Policy Brief: Africa Institute of South Africa, Pretoria.

Manyisa, Z. M., & van Aswegen, E. J. (2017). Factors affecting working conditions in public hospitals: A literature review. *International journal of Africa nursing sciences*, *6*, 28-38.

Maphumulo, W. T., & Bhengu, B. R. (2019). Challenges of quality improvement in the healthcare of South Africa post-apartheid: A critical review. *Curationis*, *42*(1), 1-9

Maputi, S. (2017). Retrieved from: https://www.parliament.gov.za/news/litigation-costs-eat-health-departments-budget-eastern-cape-and-hampering-services

Mark, T. L., Evans, W. N., Schur, C. L., & Guterman, S. (1998). Hospital-physician arrangements and hospital financial performance. *Medical care*, 67-78.

Marmaras, N., Lioukas, S., & Laios, L. (1992). Identifying competences for the design of systems supporting complex decision-making tasks: A managerial planning application. Ergonomics, 35(10), 1221-1241.

Marras, W. S., & SCHOENMARXLIN, R. W. (1993). Wrist motions in industry. *Ergonomics*, *36*(4), 341-351.

Mashego, T. A., & Peltzer, K. (2005). Community perception of quality of (primary) health care services in a rural area of Limpopo Province, South Africa: a qualitative study. *Curationis*, *28*(2), 13-21

Maurino, D. (1995). Human Factors: Safety in High Technology Systems. *Broookfield, VT Avebury*.

Mayeng, L. M., & Wolvaardt, J. E. (2015). Patient safety culture in a district hospital in South Africa: An issue of quality. *curationis*, *38*(1), 1-7

Mayosi, B. M., Flisher, A. J., Lalloo, U. G., Sitas, F., Tollman, S. M., & Bradshaw, D. (2009). The burden of non-communicable diseases in South Africa. *The lancet*, *374*(9693), 934-947.

McAlearney, A. S. (2006). Leadership development in healthcare: a qualitative study. *Journal of Organizational Behavior: the International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *27*(7), 967-982

McDaniel Jr, R. R., Lanham, H. J., & Anderson, R. A. (2009). Implications of complex adaptive systems theory for the design of research on health care organizations. *Health care management review*, *34*(2), 191.

McFadden, K. L., Henagan, S. C., & Gowen III, C. R. (2009). The patient safety chain: Transformational leadership's effect on patient safety culture, initiatives, and outcomes. *Journal of Operations Management*, *27*(5), 390-404.

McIntyre, N., & Popper, K. (1983). The critical attitude in medicine: the need for a new ethics. *British medical journal (Clinical research ed.)*, *287*(6409), 1919.

Meadows, D. H. (1999). Leverage points: Places to intervene in a system

Meshkati, N. (1989). Technology transfer to developing countries: A tripartite micro- and macroergonomic analysis of human-organization-technology interfaces. *International Journal of Industrial Ergonomics*, *4*(2), 101-115.

Miles, S. H. (2005). *The Hippocratic Oath and the ethics of medicine*. Oxford University Press

Mileti, D. S., Gillespie, D. F., & Haas, J. E. (1977). Size and structure in complex organizations. *Social Forces*, *56*(1), 208-217

Militello, L. G., Arbuckle, N. B., Saleem, J. J., Patterson, E., Flanagan, M., Haggstrom, D., & Doebbeling, B. N. (2014). Sources of variation in primary care clinical workflow: implications for the design of cognitive support. Health informatics journal, 20(1), 35-49.

Mitchell, I., Schuster, A., Smith, K., Pronovost, P., & Wu, A. (2016). Patient safety incident reporting: a qualitative study of thoughts and perceptions of experts 15 years after 'To Err is Human'. BMJ quality & safety, 25(2), 92-99

Moray, N. (2000). Culture, politics and ergonomics. *Ergonomics*, *43*(7), 858-868.

Morel, G., Amalberti, R., & Chauvin, C. (2009). How good micro/macro ergonomics may improve resilience, but not necessarily safety. *Safety science*, *47*(2), 285-294.

Naidoo, S. (2012). The South African national health insurance: A revolution in health-care delivery!. *Journal of Public Health*, *34*(1), 149-150

National Academies of Sciences, Engineering, and Medicine. (2018). Crossing the global quality chasm: Improving health care worldwide. Washington, DC: *The National Academies Press.*

National Department of Health. (2007). *A policy on quality healthcare for South Africa*, National Department of Health, Pretoria

National Department of Health. (2011). Fast track to quality: The six most critical areas for patient-centered care, *National Department of Health,* Pretoria

National Department of Health. (2017). *National Guideline for Patient Safety Incident Reporting and Learning in the Health Sector of South Africa*, National Department of Health, Pretoria

National Health Act of South Africa, 2004

National Patient Safety Agency. (2004). Improving patient safety and incident reporting. Nursing Standard, 19(7).

Neale, G., Vincent, C., & Darzi, S. A. (2007). The problem of engaging hospital doctors in promoting safety and quality in clinical care. *The journal of the Royal Society for the Promotion of Health*, *127*(2), 87-94

Needleman, J., Pearson, M. L., Upenieks, V. V., Yee, T., Wolstein, J., & Parkerton, M. (2016). Engaging frontline staff in performance improvement: the american organization of nurse executives implementation of transforming care at the bedside collaborative. *The Joint Commission Journal on Quality and Patient Safety*, *42*(2), 61-AP5.

Neill, D. (2011). Nursing workload and the changing health care environment: a review of the literature. *Administrative Issues Journal*, *1*(2), 13

Nishtar, S. (2010). H1N1 outbreak in Pakistan: lessons learnt. *Singapore: RSIS Center for Non-Traditional Security (NTS) Studies*.

Nolan, T. W. (1998). Understanding medical systems. *Annals of internal medicine*, *128*(4), 293-298

Nolan, T. W. (2000). System changes to improve patient safety. *BMJ: British Medical Journal*, *320*(7237), 771

Norman, R., Bradshaw, D., Schneider, M., Jewkes, R., Mathews, S., Abrahams, N., ... & Collaboration, S. A. C. R. A. (2007). Estimating the burden of disease attributable to interpersonal violence in South Africa in 2000. *South African Medical Journal*, *97*(8), 653-656

Norris, B., Currie, L., & Lecko, C. (2012). The importance of applying human factors to nursing practice. Nursing Standard (through 2013), 26(32), 36.

O'Connor, P., Ritchie, J., Drouin, S., & Covell, C. L. (2012). Redesigning the workplace for 21st century healthcare. *Healthc Q*, *15*, 30-5

Oakes, J. M., & Rossi, P. H. (2003). The measurement of SES in health research: current practice and steps toward a new approach. *Social science & medicine*, *56*(4), 769-784

Odberg, K. R., Hansen, B. S., Aase, K., & Wangensteen, S. (2020). A work system analysis of the medication administration process in a Norwegian nursing home ward. *Applied Ergonomics*, *86*, 103100.

Olds, D. M., & Clarke, S. P. (2010). The effect of work hours on adverse events and errors in health care. *Journal of safety research*, *41*(2), 153-162.

Parasuraman, R., Masalonis, A. J., & Hancock, P. A. (2000). Fuzzy signal detection theory: Basic postulates and formulas for analyzing human and machine performance. *Human Factors*, *42*(4), 636-659.

Pasmore, W. A. (1988). *Designing effective organizations: The sociotechnical systems perspective* (Vol. 6). John Wiley & Sons Inc. Pasmore, W. A. (1988). *Designing effective organizations: The sociotechnical systems perspective* (Vol. 6). John Wiley & Sons Inc.

Patriarca, R., Bergström, J., Di Gravio, G., & Costantino, F. (2018). Resilience engineering: Current status of the research and future challenges. *Safety Science*, *102*, 79-100.

Patterson, E. S., Cook, R. I., & Render, M. L. (2002). Improving patient safety by identifying side effects from introducing bar coding in medication administration. Journal of the American Medical Informatics Association, 9(5), 540-553

Paul, J. (2005). Healthy workplace design for healthcare staff. *Design & Health IV-Future Trends in Healthcare Design*, 43-52

Peerally, M. F., Carr, S., Waring, J., & Dixon-Woods, M. (2017). The problem with root cause analysis. *BMJ Qual Saf*, *26*(5), 417-422.

Perry, L., & Malkin, R. (2011). Effectiveness of medical equipment donations to improve health systems: how much medical equipment is broken in the developing world?

Pillay, R. (2009). Work satisfaction of professional nurses in South Africa: a comparative analysis of the public and private sectors. *Human resources for Health*, *7*(1), 15.

Plsek, P. (2001). Redesigning health care with insights from the science of complex adaptive systems. *Crossing the quality chasm: A new health system for the 21st century*, 309-322.

Plsek, P. E., & Greenhalgh, T. (2001). The challenge of complexity in health care. Bmj, 323(7313), 625-628

Preece, M. H., Hill, A., Horswill, M. S., & Watson, M. O. (2012). Supporting the detection of patient deterioration: observation chart design affects the recognition of abnormal vital signs. Resuscitation, 83(9), 1111-1118.

Pronovost, P. J., Goeschel, C. A., Marsteller, J. A., Sexton, J. B., Pham, J. C., & Berenholtz, S. M. (2009). Framework for patient safety research and improvement. *Circulation*, *119*(2), 330-337.

Punnett, L. (1998). Ergonomic stressors and upper extremity disorders in vehicle manufacturing: cross sectional exposure-response trends. *Occupational and Environmental Medicine*, *55*(6), 414-420.

Puro, V., De Carli, G., Petrosillo, N., & Ippolito, G. (2001). Risk of exposure to bloodborne infection for Italian healthcare workers, by job category and work area. *Infection Control & Hospital Epidemiology*, *22*(4), 206-210

Rafter, N., Hickey, A., Condell, S., Conroy, R., O'Connor, P., Vaughan, D., & Williams, D. (2015). Adverse events in healthcare: learning from mistakes. *QJM: An International Journal of Medicine*, *108*(4), 273-277.

Rasmussen, J. (1997). Risk management in a dynamic society: a modelling problem. Safety science, 27(2), 183-213

Rasmussen, J., & Suedung, I. (2000). *Proactive risk management in a dynamic society*. Swedish Rescue Services Agency.

Read, G. J., Salmon, P. M., Lenné, M. G., & Stanton, N. A. (2015). Designing sociotechnical systems with cognitive work analysis: putting theory back into practice. *Ergonomics*, *58*(5), 822-851.

Reason, J. (1990). *Human error*. Cambridge university press.

Reason, J. (1995). Understanding adverse events: human factors. *BMJ Quality & Safety*, *4*(2), 80-89

Reason, J. (2000). Human error: models and management. Bmj, 320(7237), 768-770.

Reiling, J. (2006). Safe design of healthcare facilities. *BMJ Quality & Safety*, *15*(suppl 1), i34-i40

Reiling, J. G., Knutzen, B. L., Wallen, T. K., McCullough, S., Miller, R., & Chernos, S. (2004). Enhancing the traditional hospital design process: a focus on patient safety. The Joint Commission Journal on Quality and Safety, 30(3), 115-124

Ridelberg, M., Roback, K., & Nilsen, P. (2014). Facilitators and barriers influencing patient safety in Swedish hospitals: a qualitative study of nurses' perceptions. *BMC nursing*, *13*(1), 23.

Roberts MJ, Hsiao W, Berman P, Reich MR. (2008) Getting health reform right: a guide to improving performance and equity. New York, Oxford University Press, 2008

Roberts, K. H., & Bea, R. (2001). Must accidents happen? Lessons from high-reliability organizations. *Academy of Management Perspectives*, *15*(3), 70-78.

Roemer, M. I., & Friedman, J. W. (1971). *Doctors in hospitals: medical staff organization and hospital performance*. Johns Hopkins University Press.

Rogers, A. E., Hwang, W. T., Scott, L. D., Aiken, L. H., & Dinges, D. F. (2004). The working hours of hospital staff nurses and patient safety. *Health affairs*, *23*(4), 202-212.

Roth, E. M., DePass, E. P., Scott, R., Truxler, R., Smith, S. F., & Wampler, J. L. (2017). Designing collaborative planning systems: Putting joint cognitive systems

principles to practice. In *Cognitive Systems Engineering* (pp. 247-268). CRC Press

Rusch, J., Amado, L., Christofides, N., & Pieters, R. (2012). National health insurance: A lofty ideal in need of cautious, planned implementation. *South African Journal of Bioethics and Law*, *5*(1), 4-10

Rutter, H., Savona, N., Glonti, K., Bibby, J., Cummins, S., Finegood, D. T., ... & Petticrew, M. (2017). The need for a complex systems model of evidence for public health. *The Lancet*, *390*(10112), 2602-2604

SABC News. (2020), retrieved from: https://www.sabcnews.com/sabcnews/protesting-community-healthcare-workers-demand-permanent-jobs/ on 9 July 2020.

Safford, M. M., Allison, J. J., & Kiefe, C. I. (2007). Patient complexity: more than comorbidity. The vector model of complexity. *Journal of General Internal Medicine*, *22*(3), 382-390

SAGov (2018). URL: https://www.gov.za/node/537988

Salmon, P. M., Goode, N., Read, G. J., & Stevens, N. J. (2016). A systems thinking design approach to improve safety at rail level crossings.

Sarah Baartman District Municiplaity (SBDMun, 2017). URL: http://www.sarahbaartman.co.za/makana

Sari, A. B. A., Sheldon, T. A., Cracknell, A., & Turnbull, A. (2007). Sensitivity of routine system for reporting patient safety incidents in an NHS hospital: retrospective patient case note review. *Bmj*, *334*(7584), 79

Sarros, J. C., Cooper, B. K., & Santora, J. C. (2008). Building a climate for innovation through transformational leadership and organizational culture. *Journal of Leadership & Organizational Studies*, *15*(2), 145-158

Sauer, J., Hockey, G. R. J., & Wastell, D. G. (2000). Effects of training on short-and long-term skill retention in a complex multiple-task environment. Ergonomics, 43(12), 2043-2064

Schildmeijer, K. G. I., Unbeck, M., Ekstedt, M., Lindblad, M., & Nilsson, L. (2018). Adverse events in patients in home healthcare: a retrospective record review using trigger tool methodology. *BMJ open*, *8*(1).

Schutz, A. L., Counte, M. A., & Meurer, S. (2007). Assessment of patient safety research from an organizational ergonomics and structural perspective. *Ergonomics*, *50*(9), 1451-1484.

Schwartz, D. (Ed.). (2005). *Encyclopedia of knowledge management*. IGI Global.

Seedat, M., Van Niekerk, A., Jewkes, R., Suffla, S., & Ratele, K. (2009). Violence and injuries in South Africa: prioritising an agenda for prevention. *The Lancet*, *374*(9694), 1011-1022.

Sekhampu, T. J. (2013). Determinants of poverty in a South African township. *Journal of Social Sciences*, *34*(2), 145-153.

Sewankambo, N. K., & Katamba, A. (2009). Health systems in Africa: learning from South Africa. *The Lancet*, *374*(9694), 957-959.

Sexton, J. B., Thomas, E. J., & Helmreich, R. L. (2000). Error, stress, and teamwork in medicine and aviation: cross sectional surveys. *Bmj*, *320*(7237), 745-749.

Shaw, S., Rosen, R., & Rumbold, B. (2011). What is integrated care. *London: Nuffield Trust*, *7*

Shekelle, P. G. (2013). Quality indicators and performance measures: methods for development need more standardization. *Journal of clinical epidemiology*, *66*(12), 1338.

Shorrock, S. T. (2019). Safety Research and Safety Practice: Islands in a Common Sea. *Safety Science Research: Evolution, Challenges and New Directions*, 223.

Siddle, A.M., 2011, 'Decentralisation in South African Local Government: A critical evaluation', Degree of Doctor of Phylosophy, Doctoral thesis, University of Cape Town.

Simsekler, M. C., Card, A. J., Ward, J. R., & Clarkson, P. J. (2015). Trust-level risk identification guidance in the NHS East of England. *International Journal of Risk & Safety in Medicine*, *27*(2), 67-76.

Sithole, S. L., & Mathonsi, N. S. (2015). Local governance service delivery issues during Apartheid and post-Apartheid South Africa. *Africa's Public Service Delivery & Performance Review*, *3*(3), 5-30.

Sittig, D. F., & Singh, H. (2009). Eight rights of safe electronic health record use. Jama, 302(10), 1111-1113

Slawomirski, L., Auraaen, A., & Klazinga, N. S. (2017). The economics of patient safety.

Smith, M. J., & Carayon, P. (1995). New technology, automation, and work organization: stress problems and improved technology implementation strategies. *International Journal of Human Factors in Manufacturing*, *5*(1), 99-116

Smith, M. J., & Sainfort, P. C. (1989). A balance theory of job design for stress reduction. *International journal of industrial ergonomics*, *4*(1), 67-79.

Sohrabi, C., Alsafi, Z., O'Neill, N., Khan, M., Kerwan, A., Al-Jabir, A., ... & Agha, R. (2020).

Sonnino, R. E. (2016). Health care leadership development and training: progress and pitfalls. Journal of Healthcare Leadership, 8, 19.

Sonnino, R. E. (2016). Health care leadership development and training: progress and pitfalls. *Journal of healthcare leadership*, *8*, 19.

Soop, M., Fryksmark, U., Köster, M., & Haglund, B. (2009). The incidence of adverse events in Swedish hospitals: a retrospective medical record review study. *International journal for quality in health care*, *21*(4), 285-291.

South African health Review (2019). Retreiwved from: https://www.hst.org.za/publications/South%20African%20Health%20Reviews/SAHR%202018.pdf

South African Medical Association, 2015, Submission to Minister of Health, National Department of Health Comments in respect of White Paper for National Health Insurance for South Africa: Towards universal coverage, Pretoria, viewed 15 December 2015, from https://www.mm3admin.co.za/documents/docmanager/f447b607-3c8f-4eb7-8da4-11bca747079f/00105160.pdf

Speybroeck, N., Ebener, S., Sousa, A., Paraje, G., Evans, D. B., & Prasad, A. (2006). Inequality in access to human resources for health: measurement issues. *Geneva: World Health Organization*, 120-8.

Stander, F. W., De Beer, L. T., & Stander, M. W. (2015). Authentic leadership as a source of optimism, trust in the organisation and work engagement in the public health care sector. *SA Journal of Human Resource Management*, *13*(1), 1-12.

Stanton, N., Salmon, P. M., & Rafferty, L. A. (2013). *Human factors methods: a practical guide for engineering and design*. Ashgate Publishing, Ltd..

Stavropoulou, C., Doherty, C., & Tosey, P. (2015). How effective are incident-reporting systems for improving patient safety? A systematic literature review. The Milbank Quarterly, 93(4), 826-866.

Stevens, L. M., Cooper, J. B., Raemer, D. B., Schneider, R. C., Frankel, A. S., Berry, W. R., & Agnihotri, A. K. (2012). Educational program in crisis management for cardiac surgery teams including high realism simulation. *The Journal of thoracic and cardiovascular surgery*, *144*(1), 17-24.

Stiglitz, J., Sen, A., & Fitoussi, J. P. (2009). The measurement of economic performance and social progress revisited. *Reflections and overview. Commission on the measurement of economic performance and social progress, Paris*.

Studdert, D. M., Thomas, E. J., Burstin, H. R., Zbar, B. I., Orav, E. J., & Brennan, T. A. (2000). Negligent care and malpractice claiming behavior in Utah and Colorado. *Medical care*, 250-260.

Sutcliffe, K. M., Paine, L., & Pronovost, P. J. (2017). Re-examining high reliability: actively organising for safety. *BMJ Qual Saf*, *26*(3), 248-251.

Suter, L. G., Li, S. X., Grady, J. N., Lin, Z., Wang, Y., Bhat, K. R., ... & Drye, E. E. (2014). National patterns of risk-standardized mortality and readmission after hospitalization for acute myocardial infarction, heart failure, and pneumonia: update on publicly reported outcomes measures based on the 2013 release. *Journal of general internal medicine*, *29*(10), 1333-1340.

Taysom, E., & Crilly, N. (2017). Resilience in sociotechnical systems: the perspectives of multiple stakeholders. *She Ji: The Journal of Design, Economics, and Innovation*, *3*(3), 165-182.

Thatcher, A., & Yeow, P. H. (2018). A Sustainable System-of-Systems Approach: Identifying the Important Boundaries for a Target System in Human Factors and Ergonomics. In Ergonomics and Human Factors for a Sustainable Future (pp. 23-45). Palgrave Macmillan, Singapore.

TheHerald (2020) Retrieved from url: https://www.heraldlive.co.za/news/2020-07-09-wheels-fall-off-ec-scooter-project-do-not-meet-basic-criteria-to-be-used-as-ambulances-zweli-mkhize/

Thomas, E. J., & Brennan, T. A. (2000). Incidence and types of preventable adverse events in elderly patients: population based review of medical records. *Bmj*, *320*(7237), 741-744.

Transparency International. (2013). Global corruption report. Taylor & Francis.

Trist, E. L., & Bamforth, K. W. (1951). Some social and psychological consequences of the longwall method of coal-getting: An examination of the psychological situation and defences of a work group in relation to the social structure and technological content of the work system. *Human relations*, *4*(1), 3-38.

Van den Hombergh, P., Künzi, B., Elwyn, G., van Doremalen, J., Akkermans, R., Grol, R., & Wensing, M. (2009). High workload and job stress are associated with lower practice performance in general practice: an observational study in 239 general practices in the Netherlands. BMC Health Services Research, 9(1), 1-8

Van Eerd, D., King, T., Keown, K., Slack, T., Cole, D. C., Irvin, E., ... & Bigelow, P. (2016). Dissemination and use of a participatory ergonomics guide for workplaces. Ergonomics, 59(6), 851-858.

Van Tilburg, C. M., Leistikow, I. P., Rademaker, C. M. A., Bierings, M. B., & Van Dijk, A. T. H. (2006). Health care failure mode and effect analysis: a useful proactive risk analysis in a pediatric oncology ward. *BMJ Quality & Safety*, *15*(1), 58-63.

Varela, F. J., & Coutinho, A. (1991). Second generation immune networks. *Immunology today*, *12*(5), 159-166

Vaughn, V. M., Saint, S., Krein, S. L., Forman, J. H., Meddings, J., Ameling, J., ... & Chopra, V. (2019). Characteristics of healthcare organisations struggling to improve quality: results from a systematic review of qualitative studies. *BMJ quality & safety*, *28*(1), 74-84

Veld, M. & Van De Voorde, K., 2014, 'How to take care of nurses in your organization: Two types of exchange relationships compared', Journal of Advanced Nursing 70, 855–865. https://doi.org/10.1111/jan.12247

Vicente, K. (1999). Cognitive work analysis. Mahwah, NJ: LEA

Vicente, K. J. (1999). *Cognitive work analysis: Toward safe, productive, and healthy computer-based work*. CRC Press

Vincent, C. (2010). How to improve patient safety in surgery. Journal of health services research & policy, 15(1_suppl), 40-43

Vincent, C., Davy, C., Esmail, A., Neale, G., Elstein, M., Cozens, J. F., & Walshe, K. (2006). Learning from litigation. The role of claims analysis in patient safety. Journal of evaluation in clinical practice, 12(6), 665-674

Vincent, C., Neale, G., & Woloshynowych, M. (2001). Adverse events in British hospitals: preliminary retrospective record review. *Bmj*, *322*(7285), 517-519.

Vincent, C., Taylor-Adams, S., & Stanhope, N. (1998). Framework for analysing risk and safety in clinical medicine. *Bmj*, *316*(7138), 1154-1157.

Vink, P., Imada, A. S., & Zink, K. J. (2008). Defining stakeholder involvement in participatory design processes. *Applied Ergonomics*, *39*(4), 519-526

Vosper, H., & Hignett, S. (2018). A UK Perspective on Human Factors and Patient Safety Education in Pharmacy Curricula. *American Journal of Pharmaceutical Education*, *82*(3), 6184

Wachter, R. M. (2012). *Understanding patient safety. 2*. New York, NY: McGraw-Hill Medical.

Wagenmakers, E. J., van der Maas, H. L., & Farrell, S. (2012). Abstract Concepts Require Concrete Models: Why Cognitive Scientists Have Not Yet Embraced Nonlinearly Coupled, Dynamical, Self-Organized Critical, Synergistic, Scale-Free, Exquisitely Context-Sensitive, Interaction-Dominant, Multifractal, Interdependent Brain-Body-Niche Systems. *Topics in Cognitive Science*, *4*(1), 87-93.

Walker, B., Holling, C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social–ecological systems. *Ecology and society*, *9*(2).

Walker, G. H., Stanton, N. A., Salmon, P. M., Jenkins, D. P., & Rafferty, L. (2010). Translating concepts of complexity to the field of ergonomics. *Ergonomics*, *53*(10), 1175-1186.

Walker, J. M., Carayon, P., Leveson, N., Paulus, R. A., Tooker, J., Chin, H., ... & Stewart, W. F. (2008). EHR safety: the way forward to safe and effective systems. *Journal of the American Medical Informatics Association*, *15*(3), 272-277.

Walton-Roberts, Margaret., (2020). COVID-19 and Global Human health Resources

Wang, H.-J., Lu, C.-q., & Siu, O. (2015). Job Insecurity and Job Performance: The Moderating Role of Organizational Justice and the Mediating Role of Work Engagement. *The Journal of Applied Psychology*, *100*(4), 1249-1258.

Waterson, P. (2009). A critical review of the systems approach within patient safety research. *Ergonomics*, *52*(10), 1185-1195.

Waterson, P. (2013, April). Bridging the Research Practice Gap in Healthcare Human Factors and Ergonomics. In *Contemporary Ergonomics and Human Factors 2013: Proceedings of the international conference on Ergonomics & Human Factors 2013, Cambridge, UK, 15-18 April 2013* (p. 285). CRC Press.

Waterson, P., & Catchpole, K. (2016). Human factors in healthcare: welcome progress, but still scratching the surface. *BMJ Qual Saf*, *25*(7), 480-484

Waterson, P., Robertson, M. M., Cooke, N. J., Militello, L., Roth, E., & Stanton, N. A. (2015). Defining the methodological challenges and opportunities for an

effective science of sociotechnical systems and safety. *Ergonomics*, *58*(4), 565-599.

Wears, R. L. (2015). Improvement and evaluation

Weick, K. E., & Quinn, R. E. (1999). Organizational change and development. *Annual review of psychology*, *50*(1), 361-386.

Weik, K. (1987). Organizational culture as a source of reliability. California Management Review, 29(2), 112-127.

Who Quality care: http://www.who.int/servicedeliverysafety/areas/qhc/quality-uhc/en/

WHO/UNICEF Joint Water Supply, Sanitation Monitoring Programme, & World Health Organization. (2015). *Progress on sanitation and drinking water: 2015 update and MDG assessment*. World Health Organization.

Williams, D. J., Olsen, S., Crichton, W., Witte, K., Flin, R., Ingram, J., ... & Cuthbertson, B. H. (2008). Detection of adverse events in a Scottish hospital using a consensus-based methodology. *Scottish medical journal*, *53*(4), 26-30.

Wilson, E. O., & Regnier Jr, F. E. (1971). The evolution of the alarm-defense system in the formicine ants. *The American Naturalist*, *105*(943), 279-289

Wilson, J. R. (2014). Fundamentals of systems ergonomics/human factors. *Applied ergonomics*, *45*(1), 5-13

Wilson, J. R., & Sharples, S. (2015). *Evaluation of human work*. CRC press.

Wilson, R. M., Harrison, B. T., Gibberd, R. W., & Hamilton, J. D. (1999). An analysis of the causes of adverse events from the Quality in Australian Health Care Study. *Medical Journal of Australia*, *170*(9), 411-415.

Wilson, R. M., Michel, P., Olsen, S., Gibberd, R. W., Vincent, C., El-Assady, R., ... & Whittaker, S. (2012). Patient safety in developing countries: retrospective estimation of scale and nature of harm to patients in hospital. Bmj, 344, e832

Woods, D. D. (1988). Coping with complexity: the psychology of human behaviour in complex systems. In *Tasks, errors, and mental models* (pp. 128-148).

World Health Organization (WHO), 2010. Health system strengthening in the African region, retrieved from ahm.afro.who.int/issue12/ahm-12.pdf

World Health Organization declares global emergency: A review of the 2019 novel coronavirus (COVID-19). *International Journal of Surgery*.

World Health Organization. (2005). *World alliance for patient safety: WHO draft guidelines for adverse event reporting and learning systems: from information to action* (No. WHO/EIP/SPO/QPS/05.3). World Health Organization.

World Health Organization. (2008). *World Alliance for Patient Safety Progress Report* 2006-2007

World Health Organization. (2010). *Monitoring the building blocks of health systems: a handbook of indicators and their measurement strategies*. World Health Organization

World Health Organization. (2017). Patient Safety: Making health care safer. *Geneva:. Licence: CC BY-NC-SA 3.0 IGO*.

Xie, A., & Carayon, P. (2015). A systematic review of human factors and ergonomics (HFE)-based healthcare system redesign for quality of care and patient safety. *Ergonomics*, *58*(1), 33-49

Xie, A., Carayon, P., Cox, E. D., Cartmill, R., Li, Y., Wetterneck, T. B., & Kelly, M. M. (2015). Application of participatory ergonomics to the redesign of the family-centred rounds process. *Ergonomics*, *58*(10), 1726-1744

Yang, C. C., Wang, Y. S., Chang, S. T., Guo, S. E., & Huang, M. F. (2009). A study on the leadership behavior, safety culture, and safety performance of the healthcare industry. *World Academy of Science, Engineering and Technology*, *53*(1), 1148-1155.

Yassi, A., & Hancock, T. (2005). Patient safety-worker safety: building a culture of safety to improve healthcare worker and patient well-being. Healthc Q, 8(32), 8.

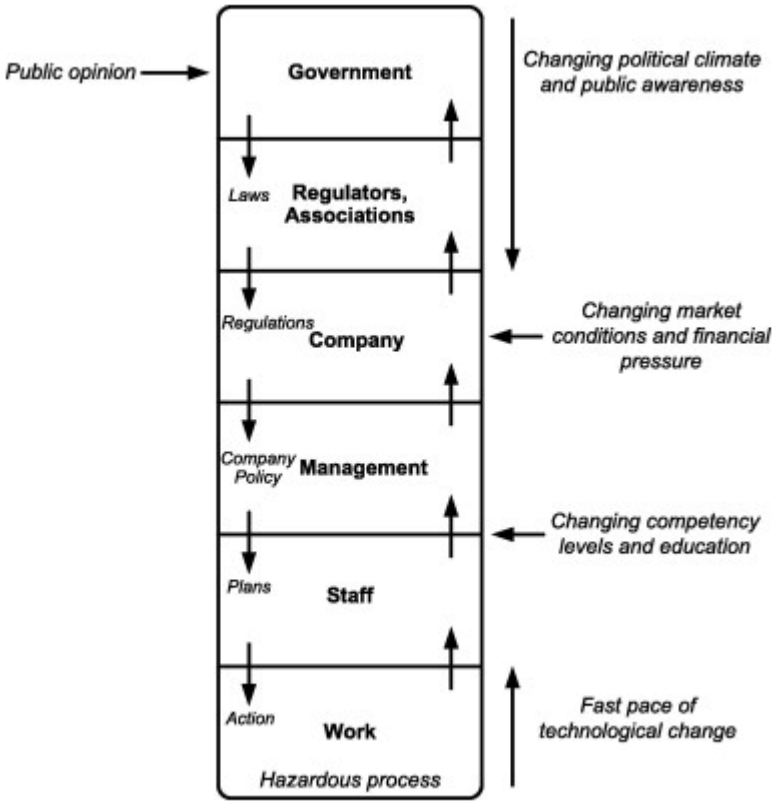
Yoshida, S. (1989). The Iceberg of ignorance. In *International Quality Symposium*.

Zegers, M., De Bruijne, M. C., Wagner, C., Hoonhout, L. H. F., Waaijman, R., Smits, M., ... & Groenewegen, P. P. (2009). Adverse events and potentially preventable deaths in Dutch hospitals: results of a retrospective patient record review study. *BMJ Quality & Safety*, *18*(4), 297-302.

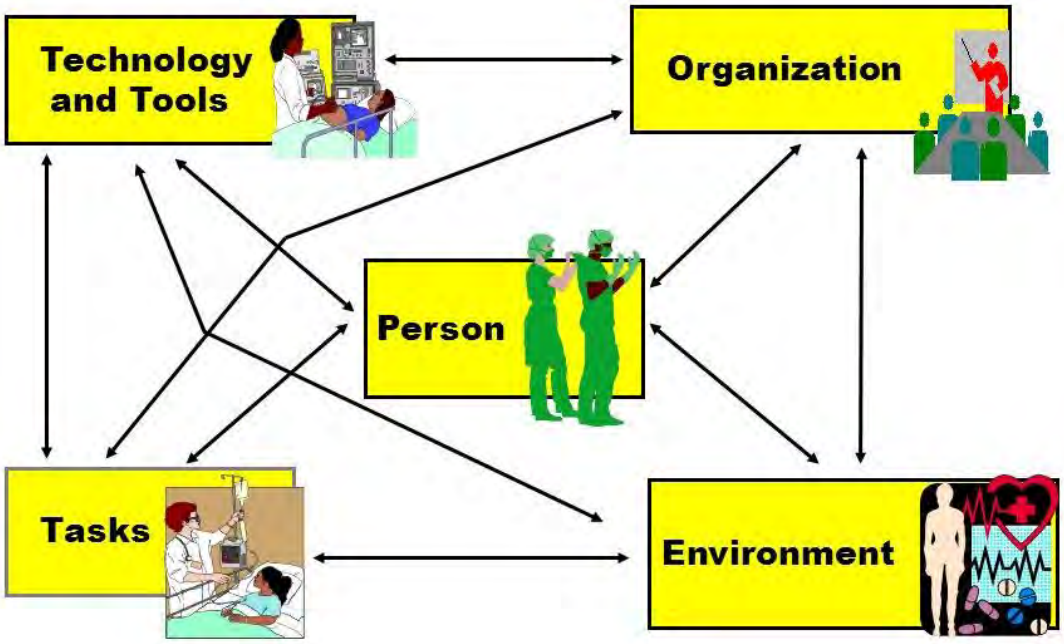
Zink, K. J. (2000). Ergonomics in the past and the future: from a German perspective to an international one. *Ergonomics*, *43*(7), 920-930.

Appendices

Appendix A: Risk Management Framework



Appendix B: work system model



Appendix C: Pre-survey presentation

RHODES UNIVERSITY

Exploring systemic challenges to health care in South Africa

Jason Card
Jonathan Davy (PhD)
Andre Todd

Department of Human Kinetics and Ergonomics; Rhodes University, Makhanda (Grahamstown)

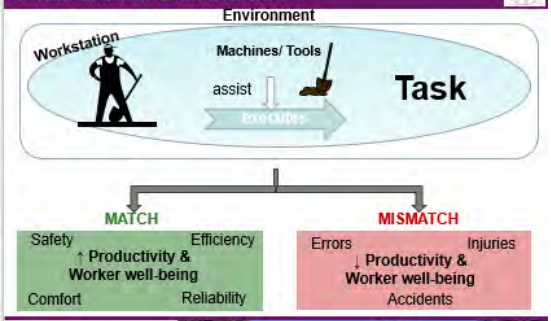
October 2019

What we do

Human Factors and Ergonomics

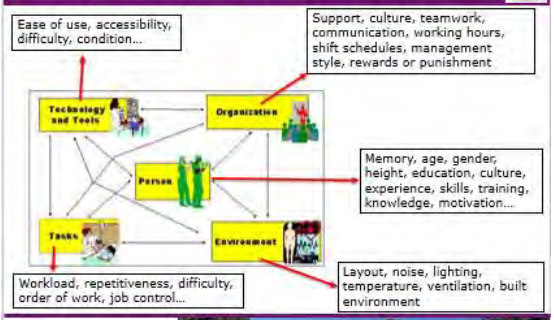
- Try to understand the 'match' between **humans** and 'the **work** that they do" in order to **improve** performance, well-being and safety
- By understanding that the **design** of work impacts how work is done, ergonomics attempts to:
  - Prevent bad things (eg. errors or stress)
  - Improve or create good things (eg. performance, satisfaction or safety)

What does HFE aim to do?



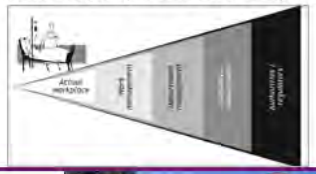
Work System

Work System characteristics (examples)



Approach to understanding work and work systems

- Stakeholders
  - **Sharp end** where work is done
    - Doctors, practitioners, nurses and even patients
  - **Bunt end** where work is designed and organised
    - Managements, policy developers, safety, leadership



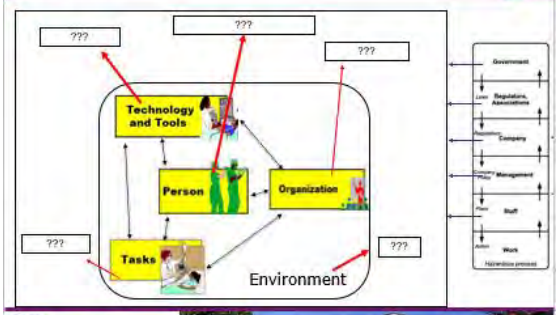
South Africa:

- South Africa experiences many challenges:
  - Quadruple burden of disease (HIV/AIDS, TB, maternal and child mortality, violence & injury)
  - Poverty, inequality, growing population
  - Dual health system
  - Rapid advancements in technology
  - Unreliable infrastructure
  - Limited resources

unfavorable characteristics = poor interactions
=
increased risk for poor quality care

The Iceberg Of Ignorance

Perceptions:



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Where leaders learn

Our Aim?

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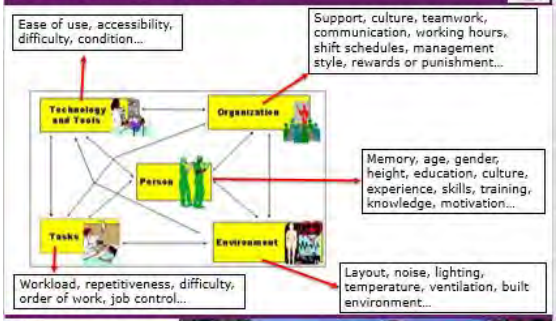
Work System characteristics



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How will this benefit?

- Explore the 'possible' disconnect (iceberg)
- Understand the challenges (from the perspective of the people who experience them)
- Guide future research to:
  - Address possible disconnect
    - (sink the iceberg so top levels can address the challenges)
  - Address challenges
    - Improve quality of care by implementing redesign / improvement strategies according to the findings

Understand challenges at different levels + understand what stakeholders think = Guide future research → IMPROVE QUALITY OF CARE

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Thank you

Questions?

Jason Card
Dr Jonathan Davy
Andrew Todd

Department of Human Kinetics and Ergonomics
Rhodes University
Grahamstown

072 915 4406
g14c5851@campus.ru.ac.za

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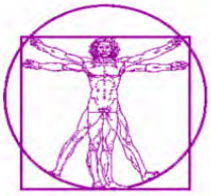
Appendix D: Letter to participant



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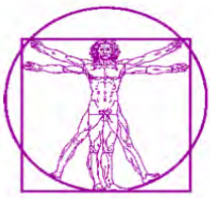

Human Kinetics and Ergonomics Department

Researcher: Jason Card - Cell: 072 915 4406 / email: g14c8661@campus.ru.ac.za

Supervisor: Jonathan Davy (PhD) - Cell: 072 226 0430 / email: jonathan.davy@ru.ac.za

Information to Participant

Dear Participant,

Thank you for your interest in participating in this research titled *"Ergonomics approach to understanding perceived barriers to the provision of high quality healthcare: A Sarah Baartman District clinics case study"* aimed at exploring your perspectives on what limits the ability to ensure safe and effective care within our health system.

You have been selected to partake in this research because as a stakeholder, any decisions or behaviours you make contribute in one form or another to the overall performance of your organisation. Your views are important to us because the challenges that you think exist, or even challenges that you experience may explain the way in which you make decisions and behave to ultimately contribute to the provision of care. Your perspective on what limits the ability for your organisation to function safely and effectively will give valuable insights into better understanding our healthcare system and the challenges it faces.

These challenges are not clearly understood in South Africa and in order to develop and implement ways to improve health care, we need to explore and understand what you think limits your overall organisation's ability to perform, as well as what limits your ability to perform your job safely and effectively. Our discipline, Human Factors and Ergonomics (HFE) aims to understand these challenges and how they influence work, so that efforts can be made with the intention of overcoming them for a more reliable, sustainable, and safer healthcare system.

To explore and understand what you think limits the performance (safety and effectiveness) of your health system in general, as well as what you think limits the ability for you to perform your job, you will be required to complete a short survey. However, before you consent to partake in the survey, you will be offered a short presentation which aims to give you an overview of what Human Factors and Ergonomics is. This presentation will inform you on the way that various *elements* of your work system (the *people*, the *tools*, the *tasks*, the *physical environment*, and the *organisational conditions*) interact to ultimately produce desirable or non-desirable outcomes (not only to patients, but also to you as staff). The presentation will introduce a model to describe the different elements of your work, and how these elements may easily change to cause conditions which may challenge the ability to perform safe and effective work. The purpose of introducing this model will be to ensure that when

you think about the challenges, you think of the various system *elements* and how certain challenges may be characteristic of these elements.

You will be offered the opportunity to clarify or raise concerns with regards to the research. It should be noted that your participation and information provided will remain anonymous. In the case of future research, information may be reanalysed, however, your name will not be attached to your information. To add, no sensitive or vulnerable information that you provide will be used against you in any way shape or form.

The research presented has been ethically authorised under the Human Kinetics and Ergonomics Ethical Committee, Followed by the Rhodes University Ethics Committee, as well as the Department of Health's Ethical board. Once concerns and queries are settled, you will be required to sign consent stating that you understand the risks and procedures. Following this, you will be given the short survey to complete as best and honestly as you can. Completion of the survey should take no longer than 20 minutes.

The survey will consist of 3 sections aimed at characterising your demographics and job characteristics; an understanding of what you think is a challenge to health facilities in South Africa; and understanding what you think limits the performance of your job. Of the challenges you propose, you will be asked to identify what you think is the highest priority and how you think this can be overcome.

Once all the data has been collected and analysed, conclusions and recommendations will be presented to you via though a post-workshop / presentation, where the challenges and possible ergonomic suggestions to overcoming them will be visually shown to you. Possible directions for future research and solutions to addressing and overcoming these challenges may be discussed.

Your participation in this research may involve sharing 'sensitive', yet valuable information which may influence the way other staff (for example, management) interact with you. To avoid any intimidation or risk of embarrassment, your confidentiality will remain anonymous so that no information provided may be held against you. Your participation may benefit your performance, your organisation's performance, as well as insights into the perceived state of the South African public health system.

This approach is new to South Africa, and by comparing perspectives across the health system, will give valuable insights into how we can better the provision of safe and effective healthcare. If you have any concerns or further queries, please do not hesitate to contact either myself (Jason Card), or the principle supervisor (Dr Jonathan Davy)

Yours sincerely,

Jason Card

Cell: 0729154406

Email: g14c8661@campus.ru.ac.za

Dr Jonathan Davy (PhD)

Senior Lecturer and project supervisor
Office: +27 46 603 7369
Cell: +27 72 226 043

Appendix E: participant consent form

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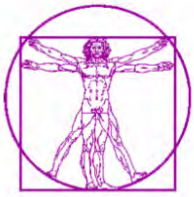


Researcher: Jason Card (g14c8661@campus.ru.ac.za; 072 915 4406)

PARTICIPANT CONSENT FORM

I, _____, have been informed of the nature of the research project entitled: "Ergonomics approach to understanding perceived barriers to the provision of high quality healthcare: A Sarah Baartman District clinics case study".

Having been informed through the information sheet attached, I am completely aware of the procedures that will take place, as well as the potential risks and benefits of participation in this particular investigation. I understand what will be expected of me as a participant, that I may withdraw my assent and participation in the investigation at any time without consequence, as well that all information gained from this project will be treated confidentially and that data obtained may be used and published for statistical or scientific purposes. I also realize that it is necessary to report any signs or symptoms of abnormality or distress experienced during the investigation promptly to the researcher.

I have had sufficient opportunity to ask questions and to clarify any concerns or misunderstandings that I may have and I am satisfied that these have been answered satisfactorily. Thus, in agreeing to voluntarily participate in this study, I accept joint responsibility together with the Human Kinetics and Ergonomics Department at Rhodes University, that should any accident or injury occur as a direct result of the protocols being performed during the study, the Human Kinetics and Ergonomics Department will be liable for any costs that may arise and will reimburse us to the full amount, i.e. doctors consultation, medication, rehabilitation etc. The department will, however, waiver any legal recourse against the researchers involved or Rhodes University, from any and all claims that result from personal injuries that are either self-inflicted, sustained due to negligence on the part of myself whilst partaking in the investigation, or from injuries not directly related to the study itself. This waiver shall be binding upon our heirs and personal representatives.

I have read and completely understood the above information, as well as the information sheet accompanying this form. Further, any questions we have had have been answered to our satisfaction. Therefore I give consent to voluntarily participate in this research project.

Participant:

_____	_____	_____
(PRINT NAME)	(SIGNED)	(DATE)

Witness:

_____	_____	_____
(PRINT NAME)	(SIGNED)	(DATE)

Appendix F: Research Survey

Exploring stakeholders' perceived challenges to the provision of safe and effective care delivery within the South African Health System

Section 1: Demographics

1. Please provide your age: _____
2. Please provide your sex: _____
3. Please provide your race: _____
4. Please provide the facility in which you work: _____
5. How much experience do you have in this facility? *(years in this facility)* _____
6. Please provide your job role (*occupation*) : _____
7. Experience (*years as role*): _____

Section 2: Perceived challenges to quality of care in South Africa

8. List up to 10 challenges that you think the South African public healthcare system faces which limits the ability to ensure high quality care

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

9. Of these, which do you think is the highest priority?

_____

10. How do you think this can be overcome?

_____

_____

Please turn over for *Section 3*

Section 3: Perceived challenges to quality of care in your work

11. List up to 10 challenges that you think limits your ability to ensure high quality care delivery

    _____

    _____

    _____

    _____

    _____

    _____

    _____

    _____

    _____

    _____

12. Of these, which do you think is the highest priority?

    _____

13. How do you think this can be overcome?

    _____

    _____

Thank you for your time. The information provided will add valuable insights into understanding, developing and improving our health system. Your input is highly appreciated.

Appendix G: List of facilities and number of participants per facility

Facility name	Number of participants
Anglo African Clinic	8
Bathurst Clinic	11
Joza Clinic	8
Kenton Clinic	10
Makana Health Sub- District Offices	5
Marselle Clinic	10
Middle Terrace	8
N.G Dlukulu	8
Nkwenkwezi Clinic	9
PAL 1 Clinic	9
PAL 2 Clinic	7
Port Alfred Town Clinic	2
Riebeek East Clinic	7
Settlers Day Hospital	5
V. Shumane	13
Total (15 facilities)	**120**

Appendix H: Rhodes University Ethical clearance

Human Ethics subcommittee
Rhodes University Ethical Standards Committee
PO Box 94, Grahamstown, 6140, South Africa
t: +27 (0) 46 603 8055
f: +27 (0) 46 603 8822
e: ethics-committee@ru.ac.za

www.ru.ac.za/research/research/ethics
NHREC Registration no. REC-241114-045

30 September 2019

Jason Card

Review Reference: 2019-0447-731

Email: g14C8661@campus.ru.ac.za

Dear Jason Card

Re: Understanding perceived barriers around providing high-quality healthcare

Principal Investigator: Dr. Jonathan Davy

Collaborators: Mr. Jason Card

This letter confirms that the above research proposal has been reviewed and **APPROVED** by the Rhodes University Ethical Standards Committee (RUESC) – Human Ethics (HE) sub-committee.

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period. You will receive an email notifying when the annual report is due.

Please ensure that the ethical standards committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloguing number allocated. Sincerely,

Prof Joanna Dames

Chair: Human Ethics sub-committee, RUESC- HE

Appendix I: Department of Health Ethical clearance

Province of the
EASTERN CAPE
HEALTH

Enquiries: Zonwabele Merile Tel no: 083 378 1202

Email: zonwabele.merile@echealth.gov.za Fax no: 043 642 1409

Date: 30 September 2019

RE: Understanding perceived barriers around providing high- quality healthcare. (EC_201907_021)

Dear Mr J. Card

The department would like to inform you that your application for the abovementioned research topic has been approved based on the following conditions:

1. During your study, you will follow the submitted protocol with ethical approval and can only deviate from it after having a written approval from the Department of Health in writing.

2. You are advised to ensure, observe and respect the rights and culture of your research participants and maintain confidentiality of their identities and shall remove or not collect any information which can be used to link the participants.

3. The Department of Health expects you to provide a progress update on your study every 3 months (from date you received this letter) in writing.

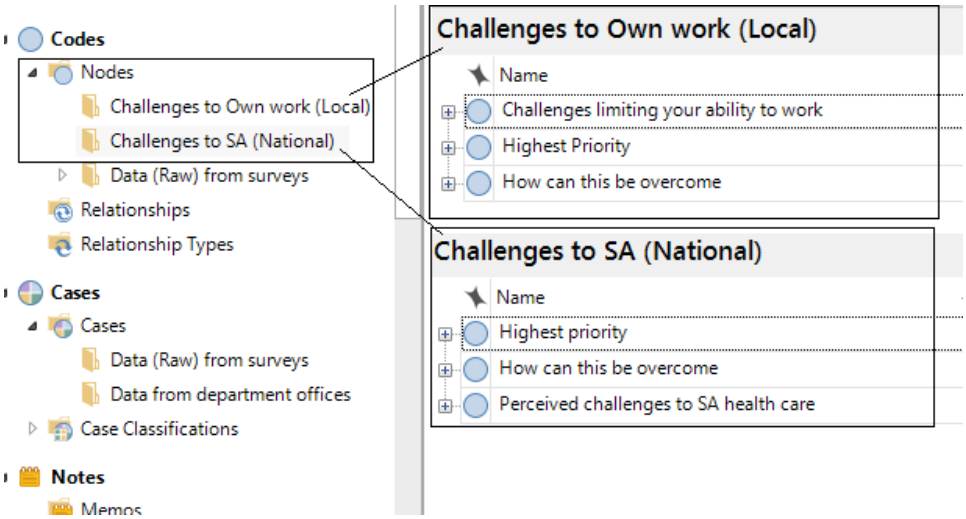
4. At the end of your study, you will be expected to send a full written report with your findings and implementable recommendations to the Eastern Cape Health Research Committee secretariat. You may also be invited to the department to come and present your research findings with your implementable recommendations.

5. Your results on the Eastern Cape will not be presented anywhere unless you have shared them with the Department of Health as indicated above.

Your compliance in this regard will be highly appreciated.

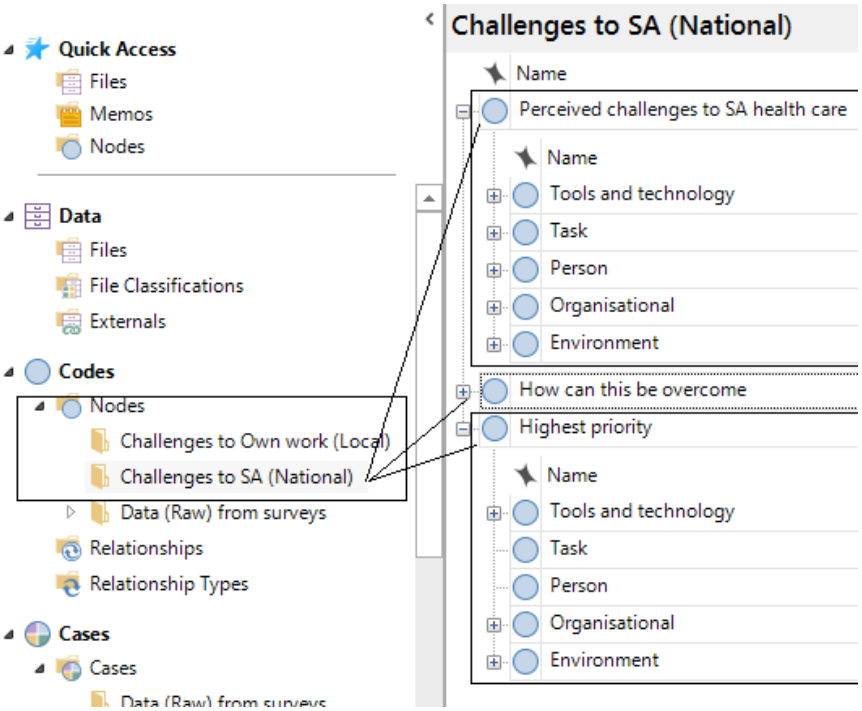
SECRETARIAT: EASTERN CAPE HEALTH RESEARCH COMMITTEE

Appendix J



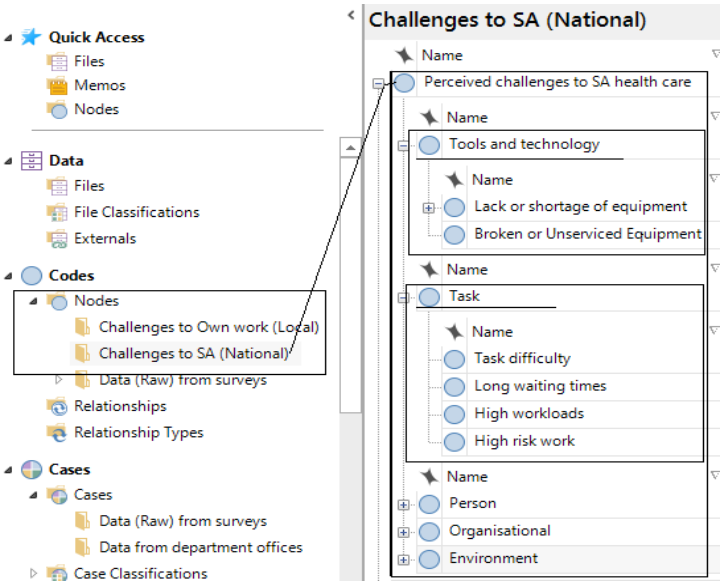
Analysis process using Nvivo

Appendix K



Analysis process 2 using Nvivo12

Appendix L



Analysis process 3, from Nvivo12

Appendix M: Definitive quotes describing the reported barriers

Reported barriers / Theme	*Definitive Quote / Example*
Organisational	
Lack of staff	*"Shortage of staff especially lower category e.g. assistant nurse, staff nurse, administration clerk, receptionists, also in need of operational manager for day to day administration and overall supervision of facility as whole." - Nurse* *"Lack of available posts for pharmacists at clinics yet no posts available or created and so many pharmacists currently unemployed." - Pharmacist*
High Numbers of patients	*"Overflow of patients" - CHBC worker.* *"Patients from other facilities come to Kenton due to booking system, making workloads higher" - Pharmacist*
Poor Management and Leadership	*"Management not visiting us in clinic; "Management take time to visit and see out problem" - Nurse* *"no monitoring from management and support"; "Appreciation of available staff and start recognising hard work." - Nurse*
Poor adherence to policy and guidelines	*"Staff does not put in hard work as they should." - pharmacist* *"Poor work ethic of some staff. "Don't care" attitude of some staff with no consequences." - Pharmacist* *"Not enough guidelines in place." - Nurse*
Lack of training	*"Lack of training - never sent for training" - CHBC worker* *"Staff not adequately trained and knowledge not up to standard in all areas"; "Pharmacist assistants are not properly trained regarding knowledge in pharmacology" - Pharmacist* *"The skills are not developed where they should be." - Management*
Job Security	*"Absorption of staff (permanent jobs)."; "Government is not employing permanent nurses" - Nurse* *"More working hours without being permanent" - CHBC worker*
Poor Service Delivery	*lack of healthy water; "Delaying with my stock ordering and material." - CHBC worker* *"No backup of electricity like generator when there is no electricity for vaccines."; "When the supplier is out of stock" - Pharmacy* *"Local municipality stops water without notice, toilets cannot be flushed." - Maintanane worker*
Poor systems in place	*"Record keeping must be kept at all times." - CHBC worker* *"We have to use the police, counsellor and area counsellor for tracing of clients"; "Ineffective systems in place e.g. supply chain, PMDS" - Nurse* *"Poor systems in place (the office is not functioning and this has a ripple effect on everyone else."; "Lack of effective and efficient systems. Poor systems in some facilities e.g. not being able to access patient files" - Pharmacy*

	"Recording is sometimes very poor, data management" - Admin Staff
Being underpaid	*Low income - CHBC worker* *"Financial frustration due to being underpaid"; " Poor remuneration." - Nurse*
Lack of communication	*"Lack of communication (training and meetings given in Xhosa)"; "Lack of communication"* *"Decisions made high up without input from ground level. " - Admin staff*
Shortage of facilities	*"shortage of clinics" - CHBC worker*
Lack of social development	*"Lack of advancement opportunities for community. " - Nurse*
Tool and Technology	
Broken or unserviced equipment	*Unavailability of working equipment. - CHBC worker* *"Equipment with poor quality, not calibrated; "Photocopy machine out of order since august and fax machine that is out of order since last year" - Nurse* *"Malfunctioning of air conditioners"; "for surgery, equipment is not calibrated and maintained" - Pharmacy*
Lack of "tools and equipment"	*"Don't have enough equipment to deliver my work as expected of me" - CHBC worker* *"Lack of resources such as computers which affects ability to dispense as manual dispensing is VERY time consuming" - Pharmacy* *"not enough equipment" - Nurse*
"Resources"	*"Shortage of resources in order to do quality care of work holistically." - Nurse* *"Availability of tangible and intangible resources" - CHBC worker*
Medication	*"Shortage of medicine" - CHBC worker*
Uniform	*"we don't have uniform, it has been +- 5 years now."; "Risk of get infected by diseases because nothing protects us"; "Being underestimated due to no uniform" - CHBC worker* *"Sometimes you don't necessary protective clothing to perform your duties"; "Lack of uniform, we only receive uniform once." - Maintenance staff*
Furniture	*"Only 4 chairs for people who came for vitals and medication have to share the chairs" - Pharmacy* *"Shortage of chairs" - CHBC worker*
Stationary	*"inadequate work resources e.g. stationary" - Nurse* *"Lack of basic equipment - paper, staples, pens." - Pharmacy* *"Shortage of chairs"*
Cleaning matarial	*"no cleaning material" - Admin Staff* *"there is no cleaning materials or there is no grass cutter." - maintenance staff*

Transportation	*"Transport for outreach nurses"; "When we are tracing the defaultersit is difficult for community health care workers because we don not have transport" - CHBC worker* *"shortage of ambulance" - CHBC worker* *"Shortage of vehicles specific for the facility as well as outreach" - Nurse* *"There is no transport to visit surrounding clinics" - Management*
Environment	
Poor Hygiene and Sanitation	*"Dumping sites around the clinic, sometimes is surrounded by septic tanks that over flow." - CHBC worker* *"Poor sanitation,"; "No cleaner, environment not good sometimes." - Nurse* *"Local municipality stops water without notice, toilets cannot be flushed" ; "The tank water is brownish, tall trees are not cut, gutters are dirty" - Maintenance staff*
Poor infrastructure	*"no paving in our yard" - CHBC worker* *"Facilities no suitable (old school building). " - Pharmacist* *"Big crack at clinic staff toilet that can cause accident."; "Steep stoep that can cause problem during disaster." - Nurse*
Inadequate space	*"The clinic is too small for the community that can be served here"; "we don't have consulting room and that distracts our work." - CHBC worker* *"Need a drug store room so that we don't run short of stock" - Pharmacist* *"Working area too small."; "No facility manager office"; "lack of storage" - Admin Staff*
Security and Safety	*"The clinic is not safe at all for the staff and the clients"; "The surrounding fence is not secured" - CHBC worker* *"No safety"; "Security, in our clinic we don't have security and sometimes client came in the facility under the influence of alcohol and they use verbal abuse and there is no security to take them out and we are not safe." - Nurse*
Person	
People are different	*"Working with people from different backgrounds" - Nurse*
Different cultures	*"Segregation of patients from each others" - CHBC worker*
Language and communication barriers	*"some are difficult, some are hard to understand" - CHBC worker* *"Language barriers" - Nurse*
Poor partient attitudes	*"Attitude from house to house visiting."; "Difficult patients."; "clients tend to be rude to the staff members" - CHBC worker* *"Attitude towards staff."; "Alcohol and drug abuse by patients leading to complications"; "they use verbal abuse and there is no security to take them out and we are not safe." - Nurse* *"Bad attitude from patients." - Pharmacist*

Poor adherence and complience	*"Drinking of patients."; "Not taking their medication" - CHBC worker* *"Poor adherence from patients" - Pharmacist*
Poor staff attitudes	*"Poor staff satisfaction" - Nurse* *"Staff attitude from neighbouring facilities"; "Poor staff attitude, not wanting to work. Laziness. Poor work ethic of some staff."; "Staff show lack of compassion towards patients." - Pharmacist*
Community health and education	*"Ignorance of both health providers and communities." - CHBC worker* *"Unemployment in community"; "Poverty - high unemployment of clients" - Nurse* *"Patients uneducated regarding their own health and constantly defaults."*
Task	
Difficulty doing tasks	*"we walk up and down the community in a hot or cold weather."; - CHBC worker* *"Setting impossible targets to reach with poor source data collected."; "Poor working conditions" - Nurse* *"Extra weekly stock measurement into a phone that takes hours. Files with original scripts missing."; "Poor systems in some facilities e.g. not being able to access patient files." - Pharmacist*
High Risk work	*"We are dealing with the patient who have lot of diseases like MDR and XDR" ; " I can say safety because we do door to door in the location where we can be the victims" ; "Risk of get affected by diseases because nothing protects us" - CHBC worker* *"working in the community is not safe, we can be robbed." ; "no staff safety" - Nurse*
Workloads	*"Overloading of work." ; "Healthcare workers burnout." ; "Too much writing work (admin)" - CHBC worker* *"overlapping roles of staff" ; "we need to clean before doing our job" ; "doing two peoples jobs." ; "One staff personnel is expected to 3 roles leading to over working and burnout" - Nurse* *"Large numbers of patients, long cues, limited time spent per patient." ; "Time wasted doing others work" - Pharmacist* *"Doing my job as data capturer and also having to do administration for the facility (staffing)" ; "Patients from other facilities come to Kenton due to booking system, making workloads higher." - Admin* *"Under staff ending up doing other peoples task lead to frustration and tiredness." ; "clients are seen until the last minute almost everyday (Therefore we have to come early by an hour to clean"*