Improving access to surgery in low- and middle-income countries through improved emergency and essential surgical care provision at district hospitals

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Table of Contents

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Format and acknowledgements

Format

This thesis is written in two parts. Part A is a literature review examining the role that district hospitals play in improving access to emergency and essential surgical care in low- and middle-income countries. Part B presents original research from a South African rural district hospital, detailing the volume and scope of surgical care provided over a seven-year period. Part B is intended to serve as a manuscript for submission to a peer-reviewed journal (South African Family Practice).

Acknowledgements

Thank you to my supervisors: Rowan, your initial pitch was that this project would be quick and easy – I'm not sure that we would have done this if our expectations had been realistic! Jo, thank you for taking me on board and guiding us through a process that Rowan and I were clearly unprepared for!

To my husband, Chris, and my daughters, Izzy and Sophie: thank you for the sacrifices you have made to allow me the space to complete this project. I am proud of what I have accomplished, but I recognise that it has been a team effort from all of us. Chris – soon you'll be back to having a part-time housewife, with energy and time for better meals, a neater home and perhaps even a data capturer for your MMed! Izzy – I am so excited to have more time for you in the afternoons; we can do more reading, more ballet, and more music. Sophie – your two-hour afternoon naps have been instrumental in getting this project done. Although I know you have outgrown them, thank you for sticking with them until the very end!

And lastly, to Madwaleni Hospital – the patients, staff, and community: without the opportunity to live and work in this environment, this project would have never been conceived. I hope your district hospital voice comes through strong and true in this work, offering insights and inspiration to strengthen district hospital surgical services in our region and beyond.

Acronyms

COVID – Coronavirus disease
CS – Caesarean section
DALY – disability-adjusted life year
DCP3 – Disease Control Priorities; 3rd edition
DH – district hospital
EC – Eastern Cape
EESC – emergency and essential surgical care
FM – Family medicine
GS – Global surgery
HIV – Human Immunodeficiency Virus
KZN – KwaZulu-Natal
LCOGS – Lancet Commission on Global Surgery
LMIC – low- and middle-income country
NHI – National Health Insurance
NIDS – national indicator dataset
NSOAP – national surgical, obstetrics, and anaesthesia plan
OT – operating theatre
PGSSC – Programme for Global Surgery and Social Change
PPH – postpartum haemorrhage
SA – South Africa
SAO – surgical, anaesthetic, and obstetric
SPC – statistical process control
TB – Tuberculosis
WHO – World Health Organization
WHO SAT - World Health Organization Surgical Assessment Tool

Key definitions

District hospital:
A district hospital, also known as a first-level hospital, serves a local community in which it is situated. It provides primary health care through a multidisciplinary team that includes nursing staff, rehabilitation professionals, generalist doctors (non-specialist), and specialist family physicians, with visiting specialists providing additional support when necessary. These hospitals deliver a wide range of services, typically focusing on medicine, surgery, obstetrics, paediatrics, psychiatry, geriatrics, rehabilitation, outpatient care, and emergency services. In South Africa, district hospitals have between 30 and 400 beds. They are referral points from community health centres or clinics, offering essential diagnostic, treatment, and rehabilitation services. They usually have at least one fully functional operating theatre (OT) to meet the district's primary surgical needs. A district hospital should meet the essential health care needs of the district, provide support to the primary health centres in the district and, in turn, be supported by the regional hospital.[1,2]

Surgery/surgical procedure:
"The incision, excision, or manipulation of tissue that requires regional or general anaesthesia, or profound sedation to control pain."[3]

Low- and middle-income countries:
The World Bank classifies countries into four income categories based on their gross national income per capita: low-income, lower-middle-income, upper-middle-income, and high-income countries. In much of the important global surgical literature (and health literature in general), low-income, lower-middle-income and upper-middle-income countries are combined into a category widely termed low- and middle-income countries (LMICs).[4,5]

Emergency and essential surgical care:
The term emergency and essential surgical care (EESC) was coined by the World Health Organization in 2005.[6] EESC refers to a set of life-saving and disability-preventing surgical procedures and related services that are considered fundamental to a functioning healthcare system. EESC typically includes a core range of general surgery, orthopaedics, anaesthesia, obstetrics, and some basic paediatric surgery. The goal is to ensure that these essential services are accessible at first-level facilities, like district hospitals, particularly in low- and middle-income countries, where timely surgical care can have a profound impact on reducing morbidity and mortality.[7]

List of tables and figures

Part A

Tables

Figures

Part B

Tables

Figures

List of appendices

Part A: The role of district hospitals in improving access to emergency and essential surgical care in low- and middle-income countries

Chapter 1 – Why should emergency and essential surgical care happen at district hospitals?

Background

Approximately one-third of the global burden of disease is attributed to surgical conditions, yet access to surgery is not available to all who need it.[1,8] Five billion people globally lack access to emergency and essential surgical care (EESC), and this results in significant morbidity and mortality.[9,10] Improving access to surgical care is thus central to achieving global health equity and universal healthcare aims.[1]

To explore the problem of access to surgery and the role of the district hospital in the solution, we conducted a literature review. An electronic search was conducted using the PubMed and Google Scholar databases, applying the following Boolean search strategy: "Hospitals, District"[Mesh] AND surg*. The search was restricted to publications in English and limited to the last 10 years. Weekly reviews were performed from July 13, 2023, to December 1, 2024, to identify any newly published relevant articles. Additionally, the reference lists of all retrieved articles were screened to capture any results that may have been missed in the initial search.

The unmet need for surgery in low- and middle-income countries

There is a disproportionately low volume of surgeries performed in low- and middle-income countries (LMICs), with the poorest 35% of the global population receiving only 3.5% of the world's surgical procedures.[11] These regions have a shortfall of 143 million surgical procedures every year.[1,9] Additionally, there is a lack of reliable epidemiological data from LMICs. Much of the data on the unmet need for surgery and surgical outputs in LMICs have been modelled on small surveys or data from high-income countries, resulting in the actual surgical need being poorly understood and likely underestimated.[12–14]

The problem of poor access to surgical care in LMICs is further exacerbated in rural areas.[8] Within countries where surgical care is limited, services are often concentrated in cities, further intensifying the service deficiency in rural areas in these regions.[15–17]

In addition to limited access to surgical care in LMICs, surgical outcomes are also poorer, especially in Africa, where patients are twice as likely to die during or after surgery than in high-income countries.[18] Therefore, whilst there is a need to increase the quantity of surgical care available in these countries, it is imperative to ensure that the quality of these services is optimised.

Emergency and essential surgery is integral to universal healthcare

Recently, equitable access to EESC has gained international prominence. The World Health Organization (WHO), World Bank, and The Lancet have significantly contributed to this discourse through influential publications and resolutions.[1,9,19]

The WHO took a crucial step in 2015 by adopting a resolution delineating key issues in EESC provision and actionable steps for member states to enhance service delivery.[19] Likewise, the

World Bank's third multi-volume publication on Disease Control Priorities (DCP3) features a comprehensive chapter dedicated to surgery, underlying its importance in global health agendas.[1] The Lancet Commission on Global Surgery (LCOGS) convened a diverse group of experts, including clinicians, researchers, and policymakers, to produce a seminal work focusing on various facets of global surgery, including healthcare delivery and management; workforce, training, and education; economics and finance; and information management for surgical services in LMICs.[9] The common thread among these important works is that the district hospital (DH), also known as a first-level hospital, is a critical vehicle for delivering surgical care.

The district hospital as the solution

District hospitals have emerged as a pivotal solution for improving access to EESC, particularly in LMICs.[1,9] These hospitals, strategically located within communities, serve as the first level of care for patients needing surgical interventions, bridging the gap between primary and tertiary healthcare centres. Many LMICs, including South Africa (SA), have established district hospitals within their government-funded health systems.

District model of healthcare delivery in South Africa

South Africa has invested heavily in a district health system.[17] This system integrates clinics and primary health care centres into communities and creates a structured referral pathway to district hospitals, which serve as the first level of referral. DHs make up 79% of all hospitals in SA.[16] They are staffed by a wide range of healthcare professionals. These include, amongst others, generalist medical officers up to the level of specialist family physicians, pharmacists, rehabilitation therapists, a variety of nursing grades, and support and administrative staff.[2,20,21] Patients who cannot be managed appropriately at DHs can be referred to secondary hospitals (also called regional hospitals), which are staffed by specialists such as surgeons, anaesthetists, and obstetricians. Patients requiring care from subspecialists can then be referred to tertiary-level facilities. Typically, clinics and primary health centres manage patients from small geographical areas, with the catchment area widening as patients are referred up the hierarchy. Since doctors and operating theatres (OTs) are typically unavailable at clinics and primary health centres, DHs are the most decentralised providers of surgical services in this system.

Most DHs are too limited by the facility size, and the volume of surgical patients, to justify service provision by specialised surgical, anaesthetic, and obstetric (SAO) providers. Therefore, providing safe and effective surgical care at these facilities requires careful planning and strategic implementation. The following sections will explore the benefits and challenges of delivering EESC at DHs, focusing on maximising their potential whilst addressing existing barriers.

Benefits of providing emergency and essential surgical care at district hospitals

Providing care closer to home

Providing decentralised surgical care at DHs reduces morbidity- and mortality-inducing delays for patients requiring surgery.[1] These delays are best understood through the Three Delays Framework: delays in seeking care, delays in reaching care, and delays in receiving care.[22] This framework has been widely used in healthcare literature and underscores the impact of decentralising healthcare services.[9,22]

Reducing delays in seeking care

The causes of delays in health-seeking behaviour are multifactorial and may include geographical limitations, financial restrictions, and cultural beliefs.[23]

The relationship between geographical limitations and health-seeking behaviour is described as the distance-decay effect, where decreased healthcare utilisation occurs with an increasing distance from a healthcare centre.[24] As with other health services, including paediatrics, family planning, and antenatal care, delivering surgical care closer to patients' homes improves the utilisation of surgical services.[25] DHs are situated close to the communities they serve, thus reducing the geographical barrier for patients seeking surgical care.

Financial restrictions are acknowledged as important factors causing delayed health seeking.[23] DHs are well positioned to mitigate the need for significant out-of-pocket expenditure incurred by patients trying to access EESC in LMICs by reducing transportation, food, and accommodation costs.[9,26] Furthermore, providing healthcare closer to home saves time related to employment and other household responsibilities.[23]

In addition to geographical and financial barriers to seeking health care, many other factors may negatively influence the health-seeking behaviour of individuals or a community. These factors include cultural beliefs which don't align with western medicine, poor education, a history of being disconnected from formal healthcare systems, low awareness of services, low confidence in services, and reliance on informal providers who are not connected to the healthcare system.[9,23] Due to the connection of district hospitals to the community they serve, some of these barriers may be able to be overcome.

Reducing delays in reaching care

The Lancet Commission on Global Surgery recommends that countries aim for 80% of the population to have access to timely EESC.[9] The LCOGS defines this target as the proportion of the population that can access, within two hours, a healthcare facility capable of performing the bellwether procedures: caesarean delivery, laparotomy, and open fracture management.[9] Dell and Chu report that 86% of South Africa's population have 2-hour access to a surgical hospital, defined as one with a functional OT and capable of performing one caesarean section annually,[27] while other studies demonstrate that 2-hour access is, in general, not available in Africa.[28] Because DHs are usually situated close to the communities they serve, if EESC can be provided effectively and safely at DHs, delays in reaching care can be minimised.

Reducing delays in receiving care

Delays in receiving care may be experienced when a patient accesses a healthcare facility that lacks both timeous EESC services and efficient referral systems. DH clinicians in South Africa report difficulty communicating with specialists to arrange transfers or give advice, and prolonged ambulance waiting times to transport patients.[29] Some delays could be reduced by capacitating DHs to provide EESC for appropriate surgical conditions at the DH level.

Providing context-specific care

In addition to reducing various types of delays, providing surgical care closer to home enables context-specific surgical care. The surgical care package at a DH can be tailored to the surgical needs of the community. Behavioural and cultural insights can also be incorporated into developing a surgical care model centred on the community being served.[30]

Reducing the burden at higher levels of care

Providing EESC effectively at DHs can benefit the regional surgical ecosystem. Secondary and tertiary hospitals in South Africa are often overburdened and have long surgical waiting lists.[31] Many South African patients with surgical conditions are inappropriately referred from DHs to higher levels of care,[32] with one-third of operations performed at tertiary hospitals in SA being more appropriately managed at a lower level of care.[33] By improving the scope and volume of surgical care at DHs, theatre time at higher levels of care can be freed up to offer surgeries more appropriate for these facilities. Providing surgery at the appropriate level of care can improve accessibility, reduce waiting times, and improve outcomes for all surgical patients.[29,34]

Economic efficiency

The delivery of surgical services at district hospitals has been presumed to be expensive, but recent studies have disproved this notion, rendering surgical services cost-effective and likely to promote economic growth.[1,9]

There is, however, some debate whether providing surgical care at DHs is more economically effective than centralising care at larger centres. By centralising any health care service, costs and risks can likely be mitigated based on larger volumes.[35] However, increasing surgical volumes at DHs would have a similar beneficial economy of scale influence on the cost of care and would minimise the patient out-of-pocket expenditure related to travelling to regional centres, as well as minimise the delays that could be incurred.[26]

While it is difficult to measure the economic impact of a specific healthcare service accurately, the measurement of disability-adjusted life years (DALY) averted is a standard, objective way of estimating the cost of different healthcare interventions. A Zambian DH has demonstrated the cost of performing a selection of basic surgical procedures was $10.70 per DALY averted.[36] The DCP3, as well as a study from Sierra Leone, puts the cost per surgical DALY averted at DHs in sub-Saharan Africa as $33.[1,37] The cost-effectiveness of offering surgical care at DHs in LMICs compares favourably with some other important public health interventions (see Table 1).

Table 1: Cost-effectiveness of important public health interventions

Intervention	Setting	Year of publication	$ per DALY averted
Vitamin A supplementation	Sub-Saharan Africa	2022	220-860[38]
Human Papillomavirus vaccine	LMICs	2017	179[39]
Antiretroviral therapy	South Africa	2013	237-1691[40]
Surgery at a DH in Sub-Saharan Africa	Sub-Saharan Africa	2006-2016	10.70-33[1,36,37]

Transferable skills and systems strengthening

DH clinicians often need to manage a wide variety of patients and pathologies, requiring a broad skill set. Providing surgical care at district hospitals may equip DH clinicians with transferable skills such as airway management, trauma management and the care of critically ill patients.[29]

Endotracheal intubation is an example of a transferable skill that may be used in the operating theatre, but it is also a valuable skill that may be needed in other clinical care areas. A clinician working at a DH without an intensive care unit or means for prolonged intubation and ventilation may perform very few emergency intubations per year, which could lead to a loss of skills due to low procedure volumes. However, if the surgical programme at DHs is expanded, clinicians will have numerous opportunities to perform elective endotracheal intubations in theatre. The skills they refine in theatre could enhance their clinical practice. Preventing skill attrition demonstrates one of the values of providing surgical services in district hospitals.

Barriers to providing emergency and essential surgical care at district hospitals

Providing emergency and essential surgical care at district hospitals in LMICs presents various challenges. These challenges include the absence of a clearly defined role for district hospitals within the health system, a lack of support from higher levels of care, inadequate financial resources allocated to surgical services at DHs, staffing shortages, and insufficient infrastructure, equipment and consumables.[14,16,29,41–44] The limited availability of reliable data exacerbates these issues, as data is an important driver of change.[9,12] Importantly, these barriers do not exist in isolation; they are interwoven within the broader health system, creating a complex web of obstacles that must be addressed holistically to improve EESC provision in LMICs.[9,45]

Lack of well-defined district hospital role

LMICs face a multifaceted burden of disease, including infectious diseases, obstetric- and neonatal-related conditions, non-communicable diseases, and trauma.[9] DHs are the first line of defence against this burden, and DH clinical teams require a wide range of skills and knowledge to meet the population's healthcare needs.

In order to meet these diverse healthcare needs, DHs have become a heterogeneous collection of healthcare facilities with no standardised definition in terms of size or services offered. In SA, the smallest DHs have less than 50 beds, and the largest DHs contain up to 600 beds.[46] These hospitals are usually staffed by generalist medical officers and family physicians, while

some DHs in SA have full-time surgeons, obstetricians, and anaesthetists.[42,47] Surgical infrastructure is variable, and many DHs do not have functioning theatres despite the reported 86% 2-hour access to surgical care.[16,27,42]

This heterogeneity creates a challenge in defining the role of DHs in the surgical ecosystem and capacitating DHs for a mandated DH service package. Numerous attempts have been made to standardise DH surgical packages, which will be further described in Chapter 2. Without a mandated DH service package, it is difficult to advocate for funding, training and resources to develop the required EESC services at DHs.

Lack of support from higher levels of care

Surgery at DHs can only exist within a surgical ecosystem. A critical component of this ecosystem is support from higher levels of care, where SAO specialists are more commonly based.[20,29,34] Appropriate support, offered through outreach, telephones, and via mobile health platforms, can have many benefits. These include benefits for patients and health care providers at the district level and for patients and health care providers at higher levels of care. For example - when DH generalist clinicians are supported by specialists, DH patients experience improved health outcomes, reduced waiting times, and reduced out-of-pocket expenditure, while the clinician at the DH is upskilled and feels supported in their service delivery.[48] While these benefits are apparent at DHs, the advantages extend to higher levels of care, where the specialist providers have an opportunity to intervene early, offer advice, and reduce unnecessary referrals. This reduces waiting times at higher levels of care for patients requiring more complex surgery.

Different methods of supporting clinicians at DHs have been suggested as important tools for improving DH surgical care. These methods include mentorship, in-reach, where DH clinicians obtain supervised exposure at larger centres, and outreach, where referral centre staff visit DHs to supervise local staff in their home environments.[29,49–51]

Despite the many benefits of fostering a supportive environment between different levels of care, South African district hospital providers of EESC have voiced their concerns regarding the difficulties they experience in this area. These clinicians describe the delays encountered when trying to reach specialists by phone and the lack of support that specialists at higher levels provide.[29,41] This includes fear of criticism, difficulties in referral due to no clear guidelines on what surgeries DHs should be providing, and doctors at higher levels of care not being sensitive to challenges faced by district healthcare services.[29,41]

Lack of finances dedicated to surgical care

Surgery is a cost-effective intervention for preventing premature death and lives lived with disability, especially when provided at DHs in developing countries.[1,37] Despite this, there is a distinct lack of allocation of funds towards surgical services, especially compared to other important public health priorities like human immunodeficiency virus (HIV), tuberculosis (TB) and malaria.[15] More than $4 billion is allocated each year to fight malaria – this funding comes from many different revenue streams, including large global organisations like the WHO and The Bill and Melinda Gates Foundation.[15,52] There are similar global funds for HIV and TB.[1] However, there are no equivalent large investors prioritising access to surgery in LMICs.

Within existing healthcare budgets, allocating sufficient funds to DH surgical programmes is necessary. These funds may be used to establish a new service (such as for infrastructure and equipment) or support the ongoing financial needs for the day-to-day operations of such a service. In SA, 39% of DHs have no budget specifically earmarked for surgery.[42] Some regard this lack of budget as the most significant non-human resource barrier to providing and expanding surgical care at DHs.[42]

Staffing

Lack of surgical, anaesthetic and obstetric providers

The LCOGS has set targets describing the number of surgical and anaesthesia providers that should be available to all populations, suggesting that by 2030, every country should have 20 surgical, anaesthetic and obstetric physicians per 100,000 population.[9] However, LMICs have a critical shortage of all healthcare professionals, especially specialists in surgery, obstetrics and anaesthesia.[15,29,42,43,53] This shortage is even more pronounced in rural areas away from main centres, where many district hospitals are located.[14] Although these specialists may not be the providers of DH surgery, their support for DH surgical programmes is vital. In a scenario where SAO providers are short-staffed and overworked in their immediate clinical environment, their capacity for support and service expansion to DHs may be limited.

Lack of recognition of non-specialist surgical, anaesthetic and obstetric providers

The SAO provider-to-population ratio target set by the LCOGS doesn't reflect the reality of surgical care at district hospitals, where surgical care is often provided by non-specialist clinicians, non-physician clinicians, or nurses.[54] There is limited data describing targets for the absolute numbers of non-specialist surgical, anaesthetic, and obstetric providers required to ensure EESC can be provided at the district level. The breadth of care offered at DHs, with clinicians often working interchangeably between different departments and performing many clinical and non-clinical tasks, makes reporting these figures challenging.

In SA, there are 1.78 surgical specialist providers per 100,000, with 60% of these practising in private healthcare facilities.[55] There are an estimated 2.9 non-specialist surgical providers per 100,000 population.[55] These figures suggest that SA has approximately 4.68 surgical providers per 100,000 people, with 60% of surgical providers being non-specialists. This number of surgical providers is well below LCOGS recommendations.[9]

Tasking shifting in surgical services

Within LMICs, there has been significant work on the concept of task shifting in surgery and the provision of EESC from non-physician clinicians such as physician assistants, nurses, and community health workers.[54] Many countries and international aid organisations have created systems supporting non-physician clinicians who have been trained to carry out a range of surgical care.[56]

South Africa has a cadre of staff labelled clinical associates. Introduced in South Africa in 2011, clinical associates perform a mid-level healthcare worker role (equivalent to physician assistants or clinical officers elsewhere in the world).[57] They receive training on various practical skills and medical knowledge and perform roles similar to general medical

practitioners.[58] In South Africa, their scope and recognition are limited, and there is minimal opportunity for career progression.[57] Within the context of task shifting in surgical care provision, this cadre could be well placed to provide expanded DH surgical services in SA.

Lack of skills

Aside from absolute staffing numbers, there are concerns about the adequacy of skills and training of surgical providers at DHs. The delivery of EESC is complex – it requires anaesthetic, perioperative and surgical skills. The lack of surgical and anaesthesia skills in South Africa are two significant barriers to offering EESC at DHs.[42] The associated lack of confidence and fear of criticism or even litigation further hamper progress.[20]

Inadequate infrastructure, equipment and consumables

Surgery is a highly cost-effective intervention. However, the implementation and maintenance of safe and effective surgical services still require investment in infrastructure, which usually comes at a significant financial cost.[15] These costs include hospital infrastructure such as operating theatres, electricity, running water for cleaning and sterilising, oxygen delivery, equipment, and surgical consumables.

Infrastructure – operating theatres

The availability of major surgical infrastructure can be measured by the number of OTs per 100,000 people.[16,44] However, no benchmark has been described. Global numbers range from more than 14 OTs per 100,000 in high-income countries to low-income countries averaging less than 2 OTs per 100,000 people.[44]

South Africa has 3.59 OTs per 100,000 total population but only 1.95 public sector OTs per 100,000 uninsured population, which is comparable to many low-income countries, despite SA being an upper-middle-income country.[44] There are even fewer theatres in rural settings compared to urban settings.[16]

Infrastructure – water, electricity, oxygen

Electricity, running water, and oxygen supplies are required to conduct safe surgery. Many DHs in LMICs have theatres but lack other critical infrastructure and equipment.[14] However, in a survey of all South African hospitals, none reported a lack of electricity, water or oxygen as a contributing factor towards non-functional theatres.[16]

Infrastructure – equipment and consumables

Consumable resources (disposable surgical supplies, medication, etc) and equipment (anaesthetic machines, theatre beds, etc) are also required.[15] Without appropriate equipment and surgical supplies, the ability to perform a wide variety of surgeries is reduced, and the safety of patients undergoing surgery may be compromised.

In some cohorts, only 32% of DHs in LMICs which perform surgery have access to functional anaesthetic machines.[59] Many hospitals in LMICs conduct anaesthesia without essential safety tools such as pulse oximeters.[44] Pulse oximetry is an established minimum monitoring standard

for surgery in only 50% of countries in Sub-Saharan Africa.[44] In this region, up to 70% of theatres operate without pulse oximetry as a standard safety measure.[44]

In South Africa, a lack of surgical supplies and non-functioning equipment (specifically anaesthetic machines) are common reasons hospitals in SA cannot utilise existing theatres.[16]

Limited data

Reliable data has the power to drive meaningful change. Without it, advocating for the increased allocation of resources needed to improve access to surgical care becomes difficult. There is limited data on the burden of disease, surgical outputs, and postoperative outcomes for DHs in LMICs, with rural settings being particularly underrepresented.[56]

The lack of reliable data from LMICs is multifactorial, with challenges arising throughout data collection, analysis and dissemination. Many LMICs still rely on paper-based patient management systems, making data extraction a time-consuming task, and delays in retrieving service-level data are common.[60] Data entry in LMICs is often the responsibility of healthcare workers, which can be laborious and detract from their ability to provide quality clinical care.[60] Additionally, the use of unvalidated instruments may produce data with uncertain accuracy, which may result in inappropriate resource allocation or misguided policy decisions.[9,60] Non-conformity of data recording, where data on the same healthcare metrics are documented in inconsistent ways within the same healthcare service, leads to difficulties in data aggregation and analysis.[60] Additionally, many LMICs lack expertise in data interpretation and analysis, resulting in the data being captured but not translated into actionable outputs.[60]

South Africa's surgical service suffers from the same lack of data as other health conditions in LMICs. Recently, there have been attempts to fill this data gap, ranging from large multinational projects to local service-level data publications (see Chapter 3).[18,42,61] However, DH-specific data is scarce, and there is no mandate to report on any surgical outputs in South Africa outside of caesarean sections, cataracts, dental extractions, male and female sterilisations and male circumcisions.[62]

Conclusion

Every year, millions of patients requiring access to EESC cannot access the care they need. This unmet need is felt most significantly in LMICs, where the burden of surgical disease is high. This situation has drawn attention from large international health organisations, who have identified various strategies to address the care gap. Strengthening of EESC provision at district hospitals is at the forefront of these suggested strategies.

DHs are well-placed to provide EESC to communities. By delivering care closer to home, district hospitals can reduce out-of-pocket expenses, improve health-seeking behaviour, and ensure timely surgical interventions, all of which contribute to better patient outcomes. There are also benefits to the broader surgical system when DHs provide an appropriate package of surgical care.

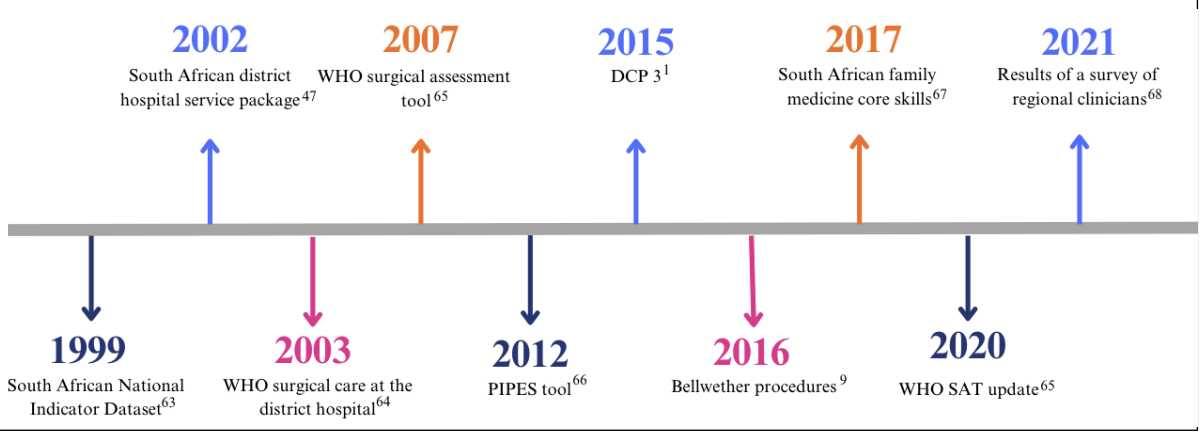
However, the successful delivery of EESC at district hospitals requires overcoming several significant barriers. These include the lack of a well-defined role for district hospitals within the broader health system, inadequate support from higher levels of care, insufficient financial

resources, staffing shortages, and the absence of essential infrastructure and equipment. Addressing these challenges will require a coordinated effort to strengthen health systems, investment in training and support for non-specialist providers, and equipping of district hospitals to meet the surgical needs of their communities.

It is essential to consider which specific emergency and essential surgical services should be prioritised at district hospitals. The next chapter will explore the types of surgical care most appropriate for district-level facilities, considering the unique needs of the populations they serve and the resources available to them. By strategically focusing on the right mix of services, the impact of surgical care at the district level can be fully realised, ultimately improving health outcomes and advancing global health equity.

Chapter 2 – Which emergency and essential surgical procedures should be delivered at district hospitals?

Figure 1: Timeline of surgical baskets of care



Ensuring that emergency and essential surgical care can be provided at district hospitals is necessary for improving access to surgery for patients in LMICs.[1,9] However, establishing standardised norms for district hospital practice has proven challenging. DHs are not uniform in their capacity to offer surgery, and this lack of standardisation complicates the design of bundles of surgical procedures that could be applicable to DHs globally, nationally, or locally. The capacity of a DH to offer surgery depends on many factors, including staffing, financial resources, infrastructure, health systems, and the local burden of disease.

Despite these challenges, there have been various attempts to develop "surgical baskets of care" containing procedures deemed essential for DHs to offer. These baskets have been developed by large international organisations (e.g. WHO and World Bank), independent expert panels, and national policymakers. Such lists are useful for planning, assessing, and monitoring the surgical capacity of individual institutions and broader surgical systems. However, there is no consensus on a universally applicable list.

The following sections describe widely recognised surgical baskets of care, identified through a review of existing literature. An electronic search was conducted using PubMed and Google Scholar, applying the Boolean search strategy: "Hospitals, District"[Mesh] AND surg*, as well as Bellwether AND surg*.The search was restricted to English-language publications from the past 10 years. Weekly reviews were performed from July 13, 2023, to December 1, 2024, to identify any newly published relevant articles. Additionally, the reference lists of all retrieved articles were screened to capture any results that may have been missed in the initial search.

The identified baskets of care are summarised in Table 2. Individual surgical procedures incorporated into each basket of care are listed in Table 3. Where necessary, the lists have been abbreviated to cover surgical procedures only, defined as "the incision, excision, or manipulation of tissue that requires regional or general anaesthesia, or profound sedation to control pain."[3] Through appraisal, comparing and contrasting existing baskets of care, we aim

to formulate ideas for a DH surgical basket of care that is contextually relevant and reflects the perspectives of local stakeholders.

Table 2: Summary of current surgical baskets of care

Suggested surgical basket of care	Year published	Development process	Number of surgical procedures	Specific to district hospitals?	Advantages	Disadvantages
South African National Indicator Dataset[63]	1999	Unknown	6	No	All public health care facilities in SA mandated to report on these indicators, small group of sentinel indicators	Unclear process of development, unsure if surgical sentinel indicators correlate with larger surgical system outputs
South African district hospital service package[47]	2002	Collaboration between national task teams and local experts	52	Yes	Specific to SA district hospitals	Some parts are vague, e.g. “deal with pelvic injury”, not updated recently, not mandated into practise
WHO Surgical care at the district hospital[64]	2003	Multi-author textbook	55	Yes	Very thorough, describes how to perform each procedure, provides insights for scenarios where specialists are not available	No recent updates, some diagnostic and therapeutic techniques outdated
WHO surgical assessment tool[65]	2007	Unknown	43	No	Thorough, acknowledges different complexities of procedures	Time consuming to administer, lack of transparency in development
PIPES tool[66]	2012	Derived from WHO SAT	31	No	Simple questions, streamlined format	Lack of transparency in development
Disease control priorities, 3rd edition[1]	2015	Specialist consensus	28	Yes	Criteria included cost effectiveness, feasibility of implementation and burden of need	Doesn’t account for the heterogeneity of DHs. Some procedures aren’t clear: “intestinal obstruction”, “surgical infections”
Bellwether procedures[9]	2016	Expert consensus and retrospective data correlation	3	Yes	Simple, short, developed in a rigorous way	Procedures themselves lack clarity,
South Africa family medicine core skills[67]	2017	Delphi consensus	55	Yes	Specific to family medicine training, includes an additional list of skills for rural district hospitals	Very broad, not only defining surgical scope, unclear if consensus has resulted in actionable change
Results of a survey of regional clinicians[68]	2021	Local clinician survey	13	Yes	Created by a group of clinicians with a variety of clinical backgrounds	Level of positive agreement arbitrarily cut off at 80%, lacks authority for implementation

Table 3: Baskets of surgical care

	Category	DCP3[1]	WHO SAT[65]	PIPES TOOL[66]	WHO surgical care at the DH[64]	Survey of Regional Clinicians[68]	SA DH service package[47]	SA family medicine core skills[67]
	Procedures related to skin, superficial soft tissue and wound management							
1	Abscess I and D	$	X	X	X		X	X
2	Biopsy of lumps and other lesions		X	X	X	X	X	X
3	Suturing of lacerations	$	X	X	X		X	X
4	Escharotomy/fasciotomy	X	X	X	X		X	X
5	Skin grafting	X	X	X	X		X	
6	Acute Burn Management			X	X		X	X
7	Removal of foreign bodies (eye, ear, nose, airway, rectum, soft tissue)		X		X		X	X
8	Dental extractions	$			X		X	X^
9	Wound debridement		X	X			X	
10	Acute management of epistaxis				X		X	X
11	Skin biopsy				X			X
12	Removal of lumps and bumps						X	X
13	Cautery/cryotherapy of warts and skin lesions						X	X
14	Fine needle aspirate							X
15	Injection of keloid							X
16	Phenol ablation of ingrown toenail							X
	General surgical procedures							
17	Repair of hernias	X	X	X	X	X	X	X^
18	Tube thoracostomy	X	X	X	X	X	X	X
19	Appendectomy	X	X	X	X	X	X	
20	Trauma laparotomy	X	X	X	X		X	
21	Cholecystectomy	X	X	X	X			
22	Repair of intestinal perforation	X	X		X			
23	Release of bowel obstruction	X	X		X			
24	Colostomy/Ileostomy	X	X		X			
25	Burr hole	X	X		X			
26	Resection and anastomosis of small bowel			X	X			
27	Proctoscopy and sigmoidoscopy				X			X^
28	Anal dilatation				X		X	
29	Incision and drainage of perianal haematoma				X			X
30	Repair of cleft lip and palate		X#	X				
31	Diagnostic peritoneal lavage				X		X	
32	Repair of anorectal malformation and Hirschsprung's Disease		X#	X				
33	Pericardiocentesis						X	
34	Thoracotomy for stabbed heart						X	
35	Craniotomy (excluding burr hole)		X					
36	Endoscopy							X^
37	Liver biopsy							X^
38	Pleural tap							X
39	Paracentesis						X	
40	Shunt for hydrocephalus		X#					
41	Paediatric abdominal wall defects			X				
42	Anal sphincterotomy							X^
	Urological procedures							
43	Hydrocelectomy	X	X	X	X	X	X	X^
44	Insertion of suprapubic catheter	X	X		X	X	X	X
45	Male circumcision	$	X	X	X		X	X
46	Vasectomy	X	X		X		X	X
47	Reduction of paraphimosis				X		X	X
48	Management of testicular torsion				X	X	X	
49	Drainage of hydrocoele				X			X
50	Orchidectomy						X	X^
51	Repair of ruptured bladder				X			
52	Urethral stricture dilatation				X			
53	Sclerotherapy for hydrocoeles						X	

54	Prostate biopsy							X^
	Orthopaedic procedures							
55	Traction for closed fracture	X		X	X	X	X	X
56	Club foot repair		X#	X	X	X	X	X
57	Irrigation and debridement of open fractures	X	X		X		X	X
58	Debridement of osteomyelitis	X	X	X	X		X	
59	Amputations (major)	X	X	X	X		X	
60	Fracture reduction and immobilization	X			X		X	X
61	Reduction of dislocations (jaw, shoulder, hip, finger, elbow)					X	X	X
62	Drainage of septic arthritis	X	X		X			
63	Management of non-displaced fractures	$	X	X				
64	Open reduction and internal fixation		X	X				X^
65	Aspiration/injection of joint (knee, ankle, shoulder, wrist)						X	X
66	Tendon repair				X			
67	Amputations (digit)							X
68	Placement of external fixator		X					
69	Contracture release			X				
	Obstetric and gynaecological procedures							
70	Caesarean Section	X	X	X	X	X	X	X
71	Tubal ligation	X	X	X	X	X	X	X
72	Laparotomy for ectopic pregnancy	X	X		X	X	X	X
73	Hysterectomy for uterine rupture or intractable postpartum haemorrhage	X	X	X	X		X	X^
74	Uterine evacuation	X	X	X	X		X	X
75	Vacuum/forceps delivery	X	X		X		X	X
76	Cervical cytology				X		X	X
77	Colposcopy	X	X					X^
78	Endometrial biopsy				X		X	X
79	Manual removal of retained placenta				X		X	X
80	Repair of perineal tears (1^{st}, 2^{nd}, 3^{rd}, 4^{th})				X		X	X
81	Cervical polypectomy				X			X
82	Culdocentesis				X			X
83	Repair of cervical and vaginal lacerations				X		X	
84	Obstetric fistula repair		X#	X				
85	Fetal craniotomy/craniocentesis				X			
86	Incision and drainage of haematocolpos				X			
87	Reduction of uterine inversion				X			
88	Laparotomy for ovarian torsion						X	
89	Perform and repair episiotomy							X
90	Large loop excision of cervical transformation zone							X^
	Ear, nose, throat and eye procedures							
91	Meibomian cyst excision				X		X	
92	Enucleation of eye						X	
93	Cataract extraction and insertion of intraocular lens		X#					
94	Eyelid surgery for trachoma		X#					
	Resuscitation and airway management							
95	Resuscitation with advanced life support measures, including surgical airway	X	X		X			X
96	Tracheostomy and surgical cricothyroidotomy			X	X		X	X
	Total procedures	***28***	***43***	***31***	***55***	***13***	***52***	***55***

X - denotes procedure included in surgical basket of care

$ - procedure suggested for lower level of care - e.g. primary health care centre

- advanced procedure

^ - additional procedures for rural and remote district hospitals

Current baskets of care

Disease Control Priorities 3

The Disease Control Priorities 3 (DCP3), published by the World Bank in 2015, outlines evidence-based, cost-effective priority health interventions that can be used to address the burden of disease in LMICs.[1] This edition spans nine volumes, with one volume dedicated to essential surgery. It is authored by a diverse group of specialists, including scholars, policymakers, and technical experts.

The authors define essential surgery as procedures that address a significant health burden, are cost-effective, and feasible. The DCP3 contains a list of 44 essential surgical procedures for provision across three service delivery platforms (primary level health care, district level, and secondary or tertiary levels). It outlines 28 surgical procedures which should be provided at the district hospital level (see Table 3). The remaining 16 procedures are also deemed part of an essential package of surgical care but are more appropriately provided at other levels of care. Nine of these procedures are appropriate for provision at primary health care facilities (for example, suturing of laceration, management of non-displaced fractures), and seven procedures should be provided at secondary or tertiary level facilities (for example, repair of obstetric fistula, repair of club foot, repair of cleft lip and palate). The DCP3 further describes policies and platforms to ensure these surgeries are delivered safely and effectively, advocating for a context-specific approach. Although these policies are theoretically sound, no country is mandated to implement them.

World Health Organization Surgical Assessment Tool

In 2007, the WHO produced the Tool for Situational Analysis to Assess Emergency and Essential Surgical Care, also known as the WHO Surgical Assessment Tool (WHO SAT).[65] This tool was designed by the WHO Initiative for Emergency and Essential Surgical Care research group. The WHO SAT was developed for baseline assessments and ongoing surveillance of surgical systems. It is a facility-based questionnaire with 176 data points across four domains, including infrastructure, human resources, surgical interventions, and emergency equipment and supplies. The tool includes 43 surgical interventions deemed essential. Of these procedures, seven are regarded as "advanced procedures"; however, the implications of this descriptor are not explained further.

There is a lack of transparency regarding how this list of essential surgical procedures was created, as the methods used in its development have not been published. Concerns about the tool's inter-user reliability were highlighted in a study which aimed to externally validate the tool. This study revealed issues with the test-retest reliability of the section related to surgical interventions.[69] These reliability issues are mainly due to provider recall but could be compounded by a lack of clarity. For example, the term "repair of club foot" could refer to casting and tenotomy (Ponseti method) or to corrective surgery. Addressing these reliability issues is crucial for ensuring the tool's effectiveness and accuracy in assessing surgical systems.

The WHO SAT was updated in 2020 through a collaboration between the WHO and the Harvard Medical School's Programme for Global Surgery and Social Change (PGSSC).[70] The updated tool, renamed the WHO/PGSSC Surgical Assessment Tool (though still widely known

as the WHO SAT), was developed using a systematic review of all available surgical assessment tools, and two rounds of Delphi consensus, during which a group of SAO specialists drew on the LCOGS National Surgical, Obstetric, and Anaesthetic Plan (NSOAP) framework and their own expert opinions.

To date, the WHO SAT (in its various editions) remains the most widely used surgical assessment tool. It has been completed in 62 countries at over 1,500 facilities, forming a rich database.[71] It has also informed many other tools and baskets of care, most notably, the bellwether procedures.

Surgeons Overseas PIPES tool

In 2012, Surgeons Overseas, an international organisation dedicated to surgical research and training in developing countries, developed a streamlined version of the WHO SAT, addressing some of the concerns related to the validity and utility of the WHO SAT. The resulting PIPES tool consists of 105 data points categorised into four domains: personnel, infrastructure, procedures, equipment, and supplies.[66] There are 31 unique surgical procedures listed in this tool.

It is easy to administer, facilitates simple data analysis, enables comparisons between facilities, and can allow for the documentation of changes in surgical capacity over time by calculating a surgical situational index. The PIPES tool has been used in many different settings – ranging from a simple checklist to more complex comparative data analyses assessing surgical services' efficiency and productivity.[72]

Bellwether procedures

The term “bellwether” originates from sheep farming, where the leading male sheep, or wether, would have a bell around his neck. This practice allowed the shepherd to locate the flock by identifying the position of only a small sample of his herd (the bellwether). Over time, “bellwether” has come to describe an indicator of trends.[73]

The concept of “bellwether procedures” was introduced in surgical literature in 2015 by the Lancet Commission on Global Surgery.[9] Details on the selection of these procedures were published the following year.[74] Experts identified three key procedures –caesarean section, laparotomy and open treatment of fractures – as indicators of a facility’s capacity to perform a broader range of other surgical procedures. Facilities with the ability to perform these procedures likely have the necessary systems, resources and skills to handle most other essential surgeries. It is also suggested that these procedures should be able to be performed at district-level hospitals.[74]

The LCOGS panel validated their bellwether theory using the WHO EESC database, which contains global data based on the WHO SAT tool. They found that facilities capable of performing these three procedures also tended to perform most other elective and emergency surgical procedures included in WHO’s primary surgery package.[74]

As a result, these three bellwether procedures have been proposed as indicators of comprehensive EESC service provision. Collecting robust data on a small set of sentinel indicators, like these procedures, may be more practical and reliable than attempting to collect

data on every surgical metric. While more extensive data sets are useful for facility or regional managers, smaller data sets are more feasible to collect and offer greater inter-user reliability. This proves especially valuable when assessing surgical capacity on a broader scale.[74] These procedures serve as a proxy to quantify surgical outputs and monitor access to care, though they should not be exclusively relied upon during the planning and implementation phases.

There have been some concerns with how the bellwether orthopaedic procedure is interpreted in the literature. The text from LCOGS uses the term "open treatment of fracture", while the title uses "treatment of open fractures". Although they sound similar, they refer to different pathologies and management approaches. "Treatment of an open fracture" involves debridement, washout, and immobilisation, whilst "open treatment of a fracture" implies internal fixation of either an open or closed fracture. This oversight has led to varied interpretations in the literature, with some authors using "treatment of open fractures" whilst other authors use "open treatment of fractures".

Since the Lancet introduced the bellwether procedures in 2015, at least 23 original research publications have utilised these indicators (see Table 4). Of these, 13 describe the orthopaedic bellwether procedure as the treatment of an open fracture, eight refer to it as the open treatment of fractures, one paper is unclear on which definition they used, and one combined both descriptions. This variation in terminology diminishes the consistency of the data, compromising the reliability and comparability of individual and pooled results.

There have also been debates in the literature regarding the appropriateness of the bellwether procedures as markers of surgical capacity. Some concerns relate to definitions; for example, the term "laparotomy" is considered too broad and lacks clarity concerning the indication or complexity of the procedure.[75]

Additionally, there are concerns that the bellwether procedures exclude the surgical needs of children.[76] Only 2 of the 34 procedures outlined in the SAT did not correlate to the availability of the bellwether procedures – neonatal surgery (e.g. imperforate anus, Hirschsprung's Disease) and repair of cleft lip and palate – both of which are paediatric surgical procedures.

It is also unclear whether any of the 23 experts who collaborated to suggest these procedures were clinicians from district hospitals. Although most participants had hands-on experience providing care in LMICs, they were not necessarily front-line clinicians.[74]

Despite these concerns, the bellwether procedures are still widely reported on because they provide an achievable proxy for understanding surgical service provision.

Table 4: Heterogeneity of orthopaedic bellwether procedures in surgical literature

	Title	Author	Year of publication	Setting	Description of orthopaedic bellwether		
					Treatment of open fractures	Open treatment of fractures	Unclear
1	Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development[9]	Meara et al	2015	LCOGS, multinational team	X		
2	Retrospective review of Surgical Availability and Readiness in 8 African countries[77]	Spiegel et al	2017	Multinational - Africa			X (open fracture management)
3	The Operative Output of District Hospitals in KwaZulu-Natal Province is Heavily Skewed Toward Obstetrical Care[61]	Tefera et al	2019	KwaZulu Natal, South Africa		X	
4	Access delays to essential surgical care using the Three Delays Framework and Bellwether procedures at Timor Leste's national referral hospital[78]	Bagguley et al	2019	Dili, Timor-Leste	X		
5	'We are all serving the same Ugandans': A nationwide mixed-methods evaluation of private sector surgical capacity in Uganda[79]	Albutt et al	2019	Uganda		X	
6	Are Rural Hospitals in Pakistan Responding to the Global Surgery Movement? An Analysis of the Gaps, Challenges and Opportunities[80]	Siddiqi et al	2019	Pakistan	X		
7	Bellwether operations in KwaZulu-Natal Province, South Africa, are performed at regional and tertiary rather than district hospitals[81]	Tefera et al	2020	KwaZulu Natal, South Africa		X	
8	Bellwether Procedures for Monitoring Subnational Variation of All-cause Perioperative Mortality in Brazil[82]	Truche et al	2020	Brazil	X		
9	Universal access to safe, affordable, timely surgical and anaesthetic care in Papua New Guinea: the six global health indicators[83]	James et al	2020	Milne Bay Province, Papua New Guinea	X		
10	District hospital surgical capacity in Western Cape Province, South Africa: A cross-sectional survey[42]	Naidu, Chu	2021	Western Cape, South Africa	X		
11	Access to Essential Surgical Care in Chiapas, Mexico: A System-Wide Geospatial Analysis[84]	Carrillo-Villaseñor et al	2021	Chiapas, Mexico	X		
12	Assessment of Delays in Emergency Surgical Care and Patient Postoperative Outcomes at a Referral Hospital in Northern Rwanda[85]	Agasaro et al	2021	Musanze, Rwanda		X	
13	Mapping timely access to emergency and essential surgical services: The Malaysian experience[86]	Hoh et al	2021	Malaysia	X		
14	Delays to essential surgery at four faith-based hospitals in rural Sub-Saharan Africa[87]	Sund et al	2021	Madagascar, Gabon, Cameroon, Burundi	X		
15	Access to surgical care in Ethiopia: a cross-sectional retrospective data review[88]	Meshesha et al	2022	Ethiopia	X		
16	Barriers to Quality Perioperative Care Delivery in Low- and Middle-Income Countries: A Qualitative Rapid Appraisal Study[89]	Bedwell et al	2022	Colombia, South Africa, Sri Lanka, Tanzania, Uganda		X	
17	Geographical Inequalities in Access to Bellwether Procedures in Brazil[90]	Faleiro et al	2022	Brazil	X		
18	Mapping population access to essential surgical care in Liberia using equipment, personnel, and bellwether capability standards[91]	Adde et al	2023	Liberia			X (Combined both categories)
19	Trends of surgical-care delivery during the COVID-19 pandemic: A multi-center study in India (IndSurg Collaboration)[92]	Jain et al	2023	India		X	
20	A national perspective on exposure to essential surgical procedures among medical trainees in Nigeria: a cross-sectional survey and recommendations[93]	Kingpriest et al	2023	Nigeria	X		
21	Geospatial mapping of 2-hour access to timely essential surgery in the Philippines[94]	Lim et al	2023	Philippines	X		
22	The impact of elective surgery postponement during COVID-19 on emergency bellwether procedures in a large tertiary center in Singapore[95]	Chan et al	2024	Singapore		X	
23	Essential surgery delivery in the Northern Kivu Province of the Democratic Republic of the Congo[96]	Malemo et al	2024	Northern Kivu, Democratic Republic of Congo		X	

Surgical Care at the District Hospital textbook

Published by the WHO in 2003, "Surgical Care at the District Hospital" is a practical and comprehensive resource for clinicians.[64] The textbook covers various relevant topics, including leadership and management of district hospitals, record-keeping, ethics, and detailed guidance on approximately 55 surgical procedures. These procedures range from simple surgical procedures like basic wound care to complex surgeries, such as splenectomy and open cholecystectomy.

The textbook is now 20 years old. An updated version is necessary to incorporate recent advancements in district-level care, such as integrating point-of-care ultrasound as a diagnostic tool. Aligning these procedures with contemporary frameworks, such as the DCP3, would improve its relevance and utility.

Results of a survey of regional clinicians

In 2018, a team of 100, predominantly African, clinicians with DH experience developed a list of surgeries which they believed should be performed at DHs in east, central, and southern Africa.[68] This proposed list was created using procedures from the Surgeons OverSeas PIPES tool, to which a yes/no format survey was applied. The researchers collated the results and rated the procedures from simple to complex, excluding very basic surgeries like suturing or abscess incision and drainage. They also clarified PIPES terminology, such as laparotomy, by adding specific indications for procedures. There were 16 unique procedures (of which three were anaesthetic techniques) that received more than 80% positive agreement from respondents and were thus suggested as appropriate for DH hospital surgery in Africa. The study also introduced the idea of a ladder of care, categorising procedures from simple to complex.

Whilst the survey lacks political weight, implementation strategies, and local burden of disease estimates, it is a rare example of local clinician collaboration on a DH basket of surgical care. Unlike the global focus of DCP3 or WHO lists, this survey targeted a regional perspective. This type of collaboration creates contextually relevant healthcare solutions.

District hospital service package for South Africa

The District Hospital Service Package for South Africa – A Set of Norms and Standards was published by South Africa's Department of Health in 2002 in response to the country's evolving district health system.[47] Developed by two national task teams, and refined by a subsequent team of experts from DHs, the package encompasses a list of 52 surgical procedures deemed appropriate for provision at South African district hospitals.

Despite its theoretical significance, the package has faced widespread implementation and reporting challenges. While it serves various purposes, such as aiding local staff in monitoring hospital performance and informing communities of their entitlement to services, its impact has been limited. No unified training or resource allocation efforts have been dedicated to the policy, and hospitals are not mandated to report on the listed procedures. Despite being created two decades ago, the package has not been updated to reflect advancements in clinical care or address evolving healthcare needs.

South African National Indicator Dataset

In 1999, the district health information system was implemented country-wide as a tool for monitoring key healthcare indicators in public healthcare in South Africa.[63] The service-level data is collected at clinics and hospitals, as well as by emergency medical services. The indicators are described and defined in South Africa's National Indicator Dataset (NIDS), which is revised every two years.[62,63] The collection and reporting of these data are mandatory in all South African public healthcare facilities. The South African Department of Health and facility managers use this data to identify needs in the healthcare system, guide budgeting, and inform programme development.

Despite this promising intervention to monitor key health indicators, the absence of surgical indicators within the NIDS database is notable. Among the 228 data points collected, only six surgical indicators exist, namely cataract surgery, male circumcision, caesarean sections, sterilisations (male and female) and dental extractions. The origins of the inclusion of these data points are unclear but could be an attempt at a sentinel analysis similar to the bellwether procedure framework.

South Africa family medicine core surgical skills

In South Africa, family physicians play a critical role in service provision at district hospitals.[97] In these hospitals, surgical care is usually provided by generalist clinicians and family physicians rather than SAO specialists. Family physicians must be competent in a wide range of clinical and non-clinical skills. Given their leadership role at DHs, family physicians require competence in the surgical procedures deemed appropriate for these facilities.

In 2015, a Delphi consensus study was conducted to refine the list of core skills for family physician training in SA.[67] This process aimed to unify family physician training across South Africa, addressing the previous issue of independent curricula at each of the eight universities offering the programme. The panel included a broad range of experts, including those with experience in district hospital services. Consensus within the Delphi process was defined as 70% agreement among all respondents. The outcome resulted in the revision of a list of core skills for family physicians, which included 42 surgical procedures.

Within this process, an important step was taken to recognise the heterogeneity of DHs, particularly in rural areas. A list specific to rural DHs, comprising 13 additional surgical procedures, was included. This recognition is crucial for addressing the unique challenges faced by rural DHs.

The interplay of current baskets of care

There are seven baskets of surgical care proposed in the above examples, excluding the bellwether procedures and the South African National Indicator Dataset, which serve as sentinel markers of surgical capacity rather than comprehensive baskets of care. These baskets collectively mention 96 unique procedures.

There is variation in the prioritisation of surgical procedures across different models. Of these 96 procedures, only five are common to all seven baskets. An additional 12 procedures are common to only six baskets, and a further seven procedures are included in only five baskets (see Table 5). Tube thoracostomies are typically performed outside the OT. This leaves the repair of hernias, hydrocelectomy, tubal ligation and caesarean section as the four most universally agreed-upon surgical procedures performed in DH OTs.

These baskets of care show inconsistencies in the inclusion of bellwether procedures. Caesarean sections are universally included, but laparotomies for obstetrics and gynaecology (hysterectomy and ectopic pregnancy) and trauma laparotomies appear in six and five of the seven baskets, respectively. Irrigation and debridement of open fractures appear in 5 of the baskets, while open reduction and internal fixation of fractures appear in only three baskets. Only three of the seven baskets contained all three bellwether procedures if the correct orthopaedic bellwether procedure definition is used (open treatment of fractures). The baskets that contain all three bellwether procedures are the WHO SAT, the PIPES tool and the South African family medicine core surgical skills list.

Table 5: Concordance of current surgical baskets of care

	Procedures incorporated in 7 baskets (100% concordance)	**Additional procedures incorporated in 6 baskets only (86% concordance)**	**Additional procedures incorporated in 5 baskets only (71% concordance)**
Concordant procedures	1.Repair of hernias 2.Tube thoracostomy 3.Hydrocelectomy 4.Caesarean section 5.Tubal ligation	1.Abscess incision and drainage 2.Biopsy (lymph nodes, masses, other small cutaneous lesions) 3.Suturing of lacerations 4.Escharotomy/Fasciotomy 5.Appendectomy 6.Insertion of suprapubic catheter 7.Male circumcision 8.Traction of closed fracture 9.Club foot repair 10.Laparotomy for ectopic pregnancy 11.Hysterectomy for intractable PPH 12.Uterine evacuation	1.Skin grafting 2.Trauma laparotomy 3.Vasectomy 4.Irrigation and debridement of open fractures 5.Major amputations 6.Debridement of osteomyelitis 7.Assisted delivery (vacuum/forceps)

The district hospital voice

DH clinicians can provide unique insights during the creation of the proposed baskets of surgical care, but their voices are missing. For instance, LCOGS has 36 authors, and it is unclear whether any are DH clinicians.[9] The exclusion of DH clinicians from such initiatives overlooks their firsthand experience and broad skill set. They bridge the gap between the theoretical perspectives of researchers and policy makers, and the practical realities of DH clinical services. Because input from this cadre of surgical providers is often left out of

published literature and global initiatives, opportunities to set more realistic and practical benchmarks are lost.[98]

Examples of the value of DH clinician input include avoiding confusing oversights, such as those that have occurred with the "management of open fractures" versus the "open management of fractures" debate. Further, their input in the discussion of surgical competencies required to manage postpartum haemorrhage (PPH) may have offered more realistic alternatives to hysterectomy, such as uterine compression sutures, uterine artery ligation, and using a Foley's catheter to tie off the base of the uterus. These temporising measures may be more feasible than hysterectomies in district settings where limited blood and blood products and no support from on-site specialists put hysterectomies out of reach of many DHs.[99]

The future of the district hospital package of surgical care in South Africa

Clearly defined surgical packages for district hospitals may make it easier to mandate training, allocate finances, and provide other resources. However, due to the heterogeneity of district hospitals and health systems, developing a universally appropriate surgical package for DHs may not be feasible. A more context-specific approach is required, involving input from local specialists, district hospital surgical providers, researchers, and policymakers.[100] This balance of experience and knowledge supports tailoring surgical packages to meet the specific surgical needs of the community and the functional capacities of DHs in different settings.

For example, a surgical package could be incorporated into a National Surgical, Obstetric, and Anaesthesia Plan (NSOAP) with allowances for the heterogeneity of district hospitals. This could include a composite calculation or situational analysis of each institution considering factors such as the number of beds, number of OTs, number of family physicians, and distance to referral hospital. Additionally, creating a ladder of EESC from simple to complex procedures can help each facility set realistic targets for expanding its surgical services as resources and capacity grow.

Additionally, a robust reporting system is essential to enable district, provincial and national decision-makers to assess the availability and quality of EESC within their jurisdictions. Beyond developing these surgical care baskets, addressing several key questions is essential: Who is responsible for delivering these services? Who is responsible for training clinicians? Who ensures the quality of care and outcomes?

Conclusion

Determining which emergency and essential surgical procedures should be delivered at district hospitals in LMICs is challenging. The varying capacities of district hospitals, influenced by factors such as staffing, infrastructure, and local disease burden, make it difficult to standardise a list of surgical procedures suitable for all contexts.

Despite these challenges, several attempts have been made to develop surgical baskets of care. These baskets aim to guide the provision of essential surgeries at DHs, offering frameworks for planning, assessing, and monitoring surgical capacity. However, the lack of consensus on

a universally applicable list and issues related to feasibility, transparency, and adaptability to local contexts have limited their effectiveness. Each of the suggested baskets of care reviewed in this chapter has its own strengths and limitations.

A more contextually relevant approach is needed – one that incorporates local stakeholder perspectives and acknowledges the diversity of DH capacities. Collaborative efforts, particularly those involving local clinicians, as seen in the survey of regional clinicians, could provide valuable insights into creating more relevant surgical baskets. By aligning these efforts with the realities of district-level healthcare delivery, particularly in LMICs, there is potential to provide a policy framework that could enable improved access to safe and effective surgical care for underserved populations.

Chapter 3 – What emergency and essential surgical care is provided at district hospitals in South Africa?

Introduction

District Hospitals have been identified as a critical resource to help bridge the gap between the number of surgeries required and the number performed. Every year, there is a deficit of millions of essential surgeries worldwide, with LMICs being hardest hit.[8] National Surgical, Obstetric, and Anaesthetic Plans have been developed or are in progress in several LMICs to address this need.[101] Similarly, South Africa has acknowledged the importance of ensuring that district hospitals offer a comprehensive and appropriate package of surgical care. Some steps have already been taken to facilitate this process, such as developing a South African district hospital service package and structuring the family medicine training programme to cover EESC appropriate for DHs.[47,67]

To effectively plan for the future of district hospital surgical care in South Africa, assessing the current surgical services provided at district hospitals and contextualising this information within the broader scope of district hospital surgical services in LMICs across the region is essential.

The following sections will explore how South Africa delivers emergency and essential surgical care at district hospitals by examining several key topics. First, we consider the structure of South Africa's healthcare system, specifically focusing on the role district hospitals play within it. Then, we examine the available data on DH surgical service provision in South Africa, situating South Africa's performance within the context of sub-Saharan Africa. This surgical service provision is described by exploring data on the volume and breadth of DH surgical procedures as well as the DH surgical providers. Incorporated into these topics are some of the barriers limiting the capacity of DHs to offer emergency and essential surgical care (see Chapter 1 for more details), thus highlighting some of the opportunities for expanding DH surgical care.

Relevant data were identified through an electronic search, conducted using the PubMed and Google Scholar databases, applying the Boolean search strategy: "South Africa"[Title/Abstract]) AND ("District Hospital*"[Title/Abstract].The search was restricted to English-language publications and limited to the last 10 years. Weekly reviews were performed from July 13, 2023, to December 1, 2024, to identify any newly published relevant articles. Additionally, the reference lists of all retrieved articles were screened to capture any results that may have been missed in the initial search.

Overview of South Africa's healthcare system

South Africa's healthcare system operates through two parallel sectors: the private health sector and the public health sector (see Table 6). The private sector is utilised primarily by those with health insurance, which accounts for only 16% of the country's population.[102] In contrast, the public health sector is government-funded and serves the majority of the population. Despite this, total healthcare expenditure in each sector is approximately equal, leading to a significant resource disparity.[103] This resource imbalance contributes to a lack of specialist surgeons in the public sector, with 60% of SA's surgeons working in the private sector.[55] These inequities are

further compounded by a lack of OTs, with 54% of OTs in SA located in private facilities. As a result, in the public sector, there are only 1.95 OTs per 100,000 people, compared to 12.21 OTs per 100,000 in the private sector.[16] The National Health Insurance Act, signed into law in SA in May 2024, creates the potential to address these imbalances and improve healthcare equity in SA's future.[104]

Table 6: Comparison of South Africa's public and private healthcare sectors

	Public sector	**Private sector**
Distribution of population[102]	84%	16%
Distribution of specialist surgeons[55]	40%	60%
Distribution of operating theatres[16]	46%	54%
OTs per 100,000 people[16]	1.95	12.21
% of healthcare expenditure[103]	50%	50%

The public health system follows a four-tiered structure organised within geographically defined health districts. The first level of care is provided at community-based clinics, which predominantly deliver nurse-led primary healthcare services. Clinics refer patients to district hospitals, where generalist doctors – and occasionally specialists – deliver care. District hospitals, in turn, refer to secondary or regional hospitals, and patients requiring more specialised care are referred to tertiary hospitals.

South Africa is divided into 52 health districts, with 252 district hospitals available in the public sector (see Table 7).[105] A cross-sectional survey suggests that only 58% of DHs in SA meet the criteria for surgical capacity, defined by the presence of a functional OT, a surgical provider and the ability to provide at least one caesarean section annually.[27] Despite this, more than 85% of the population lives within two hours of a DH with surgical capacity.[27] Regional differences occur with 80% of WC DHs able to perform surgery, and all DHs in KZN demonstrating surgical capacity.[42,61]

Table 7: Surgical infrastructure in South Africa

Province	**Population (2023)**[102]	**Number of DHs (2022/23)**[105]	**Number of OTs (2014)**[16]*	**Number of OTs per 100,000 people**^
Eastern Cape	6,536,000	65	181	2.8
Free State	3,027,000	25	125	4.1
Gauteng	16,644,000	13	711	4.3
Kwazulu-Natal	11,960,000	39	345	2.9
Limpopo	6,233,000	30	81	1.3
Mpumalanga	4,938,000	23	99	2.0
North West	4,266,000	13	91	2.1
Northern Cape	1,308,000	11	29	2.2
Western Cape	7,370,000	33	307	4.2
RSA	*62,282,000*	*252*	*1,969*	*3.2*

OT – operating theatre
** Number of OTs in the province, across all levels and both sectors*
^ assuming number of operating theatres unchanged (2014-2023)

The factors contributing to the limited surgical capacity in certain areas are not well documented, but may include a lack of theatre staff (such as nurses, anaesthetists and surgeons), non-functional anaesthetic machines, and inadequate surgical supplies.[55] There is also some concern regarding theatre efficiency in SA, which could contribute to delays in EESC across

all levels of care.[106] An in-depth discussion of barriers to providing surgical care at DHs is reported in Chapter 1.

District hospital surgical outputs in South Africa

Surgical volume at district hospitals in South Africa

To reduce the gap between met and unmet surgical needs and measure progress towards this goal, the LCOGS has recommended that all countries should be tracking their surgical volume by 2030.[9] This recommendation is echoed by the WHO, which calls for the collection and compilation of data on the number and type of surgical procedures performed.[107] However, as discussed in Chapter 1, many LMICs do not routinely track this data due to various challenges, including the absence of mandates for data recording, reliance on paper-based records, and healthcare systems historically focused on other conditions such as HIV, tuberculosis, and maternal and child health.[15,60,108] This focus may occur at the expense of EESC, which has been referred to by some as the neglected stepchild of global health.[15] Establishing accurate surgical data in these settings is imperative for effective planning, monitoring, resource allocation, and training.

The surgical volume refers to the number of procedures performed at a facility over a defined period, often described per year and per 100,000 people. Benchmarks for surgical volume have been established. The LCOGS suggests a target of 5,000 procedures per 100,000 population per year, as surgical volumes above this threshold are associated with improved health outcomes.[9,109]

Like many other LMICs, surgical volumes at DHs in SA have not been routinely reported on and are not part of routine service-level data collection. Studies have quantified district hospital surgical outputs in two South African provinces: Western Cape (WC) and KwaZulu-Natal (KZN).[42,61] However, these data account for only 28% of DHs in the country.[105]

In the WC, the mean monthly surgical volume was 355 in medium/large DHs (facilities with ≥150 in-patient beds) and 64 procedures per month at small DHs, and a substantial proportion of district-level surgeries, as outlined in SA's District Hospital Service Package, are referred to higher levels of care.[32,47] In KZN, DHs averaged 85 procedures per month. When accounting for catchment population, this translated to 1,270 procedures per 100,000 per year in small WC DHs, 655 procedures per 100,000 per year in medium/large WC DHs, and 372 procedures per 100,000 per year in KZN DHs. The composite volume for both provinces is 539 procedures per 100,000 people per year. This volume exceeds other data published from DHs in sub-Saharan Africa, where procedures per 100,000 people range from 148 in Uganda to 243 in Mozambique (see Table 8).[110]

While these volumes fall significantly short of the LCOGS target of 5,000 procedures per 100,000 population per year, the volumes described here only account for the district level of care. The volume of procedures performed at other levels of care, including secondary and tertiary, are required to produce a valid representation of this target for the South African setting. Specific targets for the volume of surgical outputs at district hospitals have not yet been established.

Table 8: Surgical volumes at district hospitals in sub-Saharan Africa

	***Small DHs*, Western Cape, South Africa**[42]	***Medium and Large DHs*, Western Cape, South Africa**[42]	**KwaZulu Natal, South Africa**[61]	**Zambia**[111]	**Ghana**[112]	**Ghana**[113]	**Tanzania**[110]	**Mozambique**[110]	**Uganda**[110]	**Malawi**[114]	**Zambia**[114]
Year	2019	2019	2015	2012 and 2016	2014-2015	2014-2015	2007	2007	2007	2014-2015	2014-2015
# of district hospitals in region quoted by publication	28	5	37	103	155	124	NR	NR	NR	50	103
# of district hospitals included	28	5	37	39	26	48	2	2	4	8	9
# of district hospitals with OT	21	5	37	NR	NR	NR	2	2	4	8	9
Mean beds per facility	NR	NR	NR	95	NR	NR	130	153	119	NR	NR
Mean monthly volume per facility	64	355	85	NR	171	250	83	33	41	NR	NR
% obstetrics and gynaecology	32%	45%	72%	NR	NR	NR	43%	57%	47%	73%	32%
% general surgery	49%	28%	12%	NR	NR	NR	NR	NR	NR	8%	10%
% orthopaedics	19%	25%	3%	NR	NR	NR	NR	NR	NR	4%	14%
Mean catchment population per facility	60 484	650 000	NR	132 688	NR	NR	429 421	162 798	332 493	NR	NR
Number of procedures per 100,000 population per year	1270	655	364	2012-166 2016-188	NR	NR	231	243	148	NR	NR
NR – not reported											

Surgical breadth at district hospitals in South Africa

The breadth of surgical care refers to the variety of surgical procedures offered by a facility, sometimes described as a surgical "basket of care". Establishing a definitive benchmark for DH surgical breadth is challenging. As discussed in Chapter 2, numerous suggestions of proposed baskets of care are specifically aimed at EESC at DHs.

In SA, the breadth of surgical care has only been described in two provinces, WC and KZN.[42,61] DHs in the WC offer a wide range of surgical procedures, with small DHs performing 22 out of 28 DCP3 DH-level procedures and medium/large DHs performing 26 out of 28 DCP3 DH-level procedures (all except burr holes and surgical airways). The most common procedures performed in WC DHs include laceration repairs, fracture reductions and immobilisations, and caesarean sections. Granular details on surgical breadth are unavailable from the KZN study, as the data was aggregated by speciality.

Obstetric and gynaecological procedures were most prevalent in KZN, accounting for 72% of total procedures, compared to 45% in medium/large DHs in the WC and 32% at small DHs in the WC. This high proportion of obstetric and gynaecology cases is primarily driven by the volume of caesarean sections, the most common operating room surgical procedures performed in both the WC and KZN. South Africa is not exceptional in its proportion of obstetric and gynaecological procedures performed at DHs. In limited samples from Mozambique, obstetric and gynaecological procedures make up 57% of DH surgical outputs, whilst in a Malawian sample, this increased to 73% (see Table 8).[110,114]

The high volume of caesarean sections compared to other surgeries may partly be due to the prioritisation and strategic focus on obstetric and neonatal care at the national level. In SA, every obstetric-related death is audited by an independent committee.[115] This commitment and drive to prevent maternal deaths and perinatal mortality has likely contributed to DHs offering effective CS services. The same attention has not been paid to other conditions amenable to surgical interventions.

In KZN, DHs located further from referral centres performed a higher proportion of orthopaedic and general surgical procedures and, thus, a more diverse surgical service, whilst DHs closer to referral centres provided higher proportions of obstetric and gynaecological procedures.[61] This may reflect self-reliance in the DHs, which are distant from referral centres. This data contrasts the suggestion from the authors of the WC study that DHs closer to referral centres might offer a broader range of surgeries or more complex procedures due to the proximity of specialists.[42]

Surgical providers at district hospitals in South Africa

Understanding the providers of EESC at DHs is critical for guiding decision-makers in developing standardised baskets of surgical care and structuring training. South Africa has 1.78 specialist surgeons per 100,000 people, with 60% of these specialists working in the private sector, primarily serving 16% of the population with health insurance. In the public sector, surgeons are concentrated in larger urban centres, and DHs are typically not staffed with SAO specialists.[116]

The only available data on DH surgical providers in SA comes from the WC, where 5 out of 33 DHs (15%) had a full-time surgical specialist, whilst 16 DHs (48%) had specialist family physicians on staff. At the remaining DHs, surgical care was provided by medical officers only.[42] In the WC, district hospitals without SAO specialists, regardless of size, tend to perform higher volumes of surgical care when a family physician is present. These hospitals displayed double the surgical output compared to DHs without family physicians.[42] These findings are localised to one region in SA, and a comprehensive picture of the providers of EESC at DHs across SA is lacking.

As discussed in Chapter 1, task-shifting is an effective way to improve staffing of surgical services in LMICs. Since 2011, South Africa has trained clinical associates who are equivalent to non-physician clinicians or clinical officers in other countries.[57] They receive training in a range of practical skills and medical knowledge and perform roles very similar to general medical practitioners.[58] However, there are no reports of EESC provision by this cadre in South Africa. This contrasts with other sub-Saharan African countries where the ability of non-physician clinicians to provide EESC at DHs has been demonstrated. In a sample from Ghana, clinical officers performed some degree of surgical care at all DHs,[112] whilst in samples from Malawi and Zambia, nearly all surgeries at DHs were performed by non-physician clinicians.[114]

Conclusion

District hospitals are critical in ensuring all South Africans can access emergency and essential surgical care. However, much remains unknown about their surgical outputs and surgical capacity. Current data, which is limited to two of the nine provinces and less than one-third of the country's population, suggests that DHs are likely underperforming relative to global surgical benchmarks. Expanding the mapping of surgical outputs across other regions in South Africa is essential for developing targeted interventions that aim to improve access to surgical care.

It is equally important to explore the factors which may promote or limit the expansion of DH surgical services in SA. These opportunities may include harnessing the skills of family physicians, who have been shown to have a significant positive impact on the volume of DH surgeries, as well as exploring the potential role of clinical associates in the provision of DH surgical care.

A comprehensive understanding of surgical services at district hospitals – including data on surgical outputs, surgical providers, and factors affecting surgical capacity – is crucial for developing effective strategies to improve access to emergency and essential surgical care in South Africa.

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Part B: A descriptive analysis of surgical services at a South African rural district hospital

This article is presented in the format of the journal South African Family Practice, available for reference in Appendix E.

Abstract word count:250
Article word count: 3 932

Abstract

Background
Surgical conditions contribute to one-third of the global burden of disease, yet many individuals in low- and middle-income countries (LMICs) lack access to emergency and essential surgical care. In South Africa, 86% of the population resides within two hours of a district hospital with basic surgical capabilities. Improving access to surgical care at district hospitals could reduce morbidity and mortality. However, detailed knowledge of surgical capacity at district hospitals is limited.

Madwaleni District Hospital, a 180-bed rural hospital in the Eastern Cape province of South Africa. This study aims to describe the volume and breadth of surgical services at provided Madwaleni Hospital, as well as the providers of surgical care.

Methods
A retrospective audit of surgical services was conducted using theatre register data from January 2016 to December 2022. Extracted data included patient demographics, surgical procedures, and surgical providers. A quantitative descriptive analysis was performed.

Results
Over the 7-year period, 2616 surgical procedures were performed. Mean monthly theatre volume increased from 27 in 2016 to 41 in 2022. Theatre utilisation averaged one case per day. Caesarean sections predominated, accounting for 82% of cases. Family medicine registrars and family physicians performed significantly more surgeries compared to other cadres.

Conclusion
Improving surgical capacity at district hospitals is essential for closing the gap between the met and unmet surgical needs in LMICs. This study highlights the capacity and opportunity to expand surgical services at rural district hospitals.

Contribution
Family medicine trainees and specialists play an important role in district hospital surgical services.

Introduction

One-third of the global burden of disease necessitates surgical, obstetric or anaesthetic care.[1] However, in low- and middle-income countries (LMICs), 90% of people either lack access to this care or face catastrophic economic consequences to obtain it.[2] To address this issue, the World Health Organization (WHO) and the Lancet Commission on Global Surgery (LCOGS) advocate for enhancing the surgical capacity of district hospitals.[2] This cost-effective solution reduces the burden on higher-level facilities, improves patient accessibility, and minimises delays.[3,4]

South Africa's public sector health services are provided within a district health system, with the district hospital often being the first entry point for patients seeking surgical care. District hospitals constitute a heterogeneous category of healthcare institutions, exhibiting significant variations in staffing, infrastructure, and capacity to deliver the package of surgical care suggested by global bodies and local regulators. Comprehensive data on the readiness of South African district hospitals to provide an essential surgical care package is lacking.[5] Existing data highlight the impact of insufficient delivery of essential and emergency surgical, obstetric, and anaesthetic care, resulting in avoidable morbidity and mortality.[6–8]

To improve access to emergency and essential surgical care (EESC), global organisations such as the World Bank and the WHO have recommended specific surgical procedures which should be offered at district hospitals.[3,9] Several African countries are developing or have established National Surgical, Obstetric and Anaesthesia Plans.[10] South Africa has sought to implement a district hospital service package outlining procedures suitable for district hospitals.[11] Tools such as the bellwether procedures and the World Health Organization Surgical Assessment Tool (WHO SAT) have been designed to assess system readiness and outputs.[12,13] Despite these efforts, examples of sustained improvements in surgical service delivery remain elusive. This may be due to the limited effectiveness of top-down directives compared to strategies that engage local healthcare providers through group problem-solving and training initiatives, drawing on the intrinsic motivation of local change agents with a desire to improve and expand district hospital surgical services.[14,15]

Our research aims to detail the surgical scope and volume at a rural district hospital in the Eastern Cape of South Africa. By examining changes in surgical service delivery over time, we seek to identify contextual factors that facilitate effective change. We hypothesise that improvements in the volume and variety of surgical procedures performed at this hospital are achievable through a combination of relevant contextual factors and targeted attempts by the local clinical team to improve the services.

We have situated this study at Madwaleni District Hospital, which has features likely to be representative of other rural district hospitals. It is a medium-sized, government-funded district hospital with 180 inpatient beds, a casualty unit and a busy outpatient department. The hospital serves approximately 100 000 people spread over a vast geographical area, making access an often lengthy and expensive task.[16,17] Additionally, this population suffers from high rates of unemployment, low literacy rates, poverty and lack of water, electricity, and sanitation.[17]

The hospital provides a wide range of clinical services, including adult medicine and surgery, paediatrics, neonatology, and obstetrics. A single team of clinicians (doctors and clinical associates) provides clinical care across all these domains. In March 2017, a decentralised family medicine training programme was launched at the hospital, offering registrars in family

medicine a four-year specialisation based at this facility under the supervision of an accredited university.

The primary referral centre is an academic hospital located two hours away by poor-quality roads, posing significant economic and logistical barriers to accessing higher levels of care. No private healthcare facilities offer surgical care in the vicinity.

Methods

Instrument and justification

We conducted a retrospective audit of operating theatre activity at Madwaleni District Hospital from January 2016 to December 2022. This 7-year timeframe was selected to capture variations in case volume and diversity of procedures over time. Descriptive data captured by theatre nursing staff during each theatre case were extracted from the theatre register. All cases over this period were included in the analysis.

The variables collected included the procedure date, patient age, patient sex, surgeon, anaesthetist, start and finish times, and the type of procedure. Clinician and patient data were de-identified. Any inconsistencies in the data were clarified by cross-referencing with clinical records and other service-level data sources. Only the primary procedure was documented in cases where multiple procedures were recorded (e.g. caesarean section and bilateral tubal ligation). In cases of missing data, supplementary sources such as delivery registers and historical call rosters were consulted to verify and retrieve omitted information. For missing operative times, mean substitution was applied.

Supplementary data were obtained and verified by the internal human resources department and the District Health Information System. This included the annual medical staff complement and their professional cadre. Local census data from Statistics South Africa were used to estimate population size.[16] Additionally, local stakeholders were consulted to identify interventions that may have impacted the surgical service. These interventions were then annotated onto a statistical process control (SPC) analysis graph for visualization and analysis.

The WHO SAT was used to comprehensively evaluate the hospital's infrastructure, human resources, interventions, equipment, and supplies.[13] The WHO SAT consists of 176 items, each scored on a scale of 0 to 3 (0 – unavailable, 1 – inadequate, 2 – limited, 3 – adequate). The WHO SAT data were collected at the conclusion of the study period in December 2022. Given the retrospective nature of the study, this tool was not completed at the study's outset. However, local stakeholders indicated that significant changes in WHO SAT domains were unlikely over the study period.

Data were checked, cleaned, aggregated, and analysed using Microsoft Excel. A statistical SPC analysis of case volume was conducted and is graphically represented. Shifting means, adjusted after eight successive points on the same side of the mean, denote the central tendency. Upper and lower control limits were set at three standard deviations. The Pearson correlation coefficient (R) was used to assess the strength of relationships of normally distributed data. The relationship between staff cadre and surgical output was compared using a Poisson model.

All confidence intervals were set at 95%. Results are reported in compliance with STROBE reporting guidelines for observational studies (see appendix F).[18]

A variable, "staff years", was created to depict the relative contribution of each cadre of staff to the surgical service. It was calculated as a product of the cadre (or cadres) of each staff member and the number of years each staff member worked in that cadre over the study period.

Data were stored in a password-protected Google Drive folder, with access granted to a limited number of investigators.

Ethical considerations

This study received approval from the UCT Human Research Ethics Committee (reference HREC 158/2023), as well as from the Eastern Cape Health Research Committee and the National Health Research Database (EC_202307_011). The hospital CEO granted authorisation for data collection. Consent from participants was not required as the data collected was from service-level sources and forms part of existing reporting tools. Additionally, there was negligible risk of harm to participants.

Results

Surgical infrastructure

The hospital's infrastructure was analysed using the WHO SAT tool (see Appendix A for full report). All five of the WHO SAT essential infrastructure items are usually available. These include electricity, running water, internet, oxygen and a 24-hour emergency unit. However, the water supply depends on electricity, and the supply of both these essential utilities is not always reliable. All pharmacy items deemed essential by the SAT are available. Imaging modalities include X-ray (limited to office hours) and ultrasound (always available). Typically, four units of emergency blood are kept on-site, and basic laboratory services are provided. A blood bank and extended laboratory services are available at the referral centre only. The hospital meets all WHO SAT-specified operating room equipment and supplies requirements.

Surgical interventions are performed in three distinct areas: the main theatre – a dedicated environment for surgery only; the minor procedures room – an area within the emergency unit where complex resuscitations and minor procedures are performed; and the outpatient department rooms – consulting rooms where short, limited procedures are performed. Further details of the surgical facilities are provided in Table 1.

Table 1: Facility characteristics for Madwaleni Hospital's surgical service areas

	Main Theatre	Minor Procedures Room	Outpatient Department
Mode of anaesthesia provided	General, regional, local, sedation	Regional, local, sedation	Local
Surgical procedures - examples	All major surgical procedures (caesarean sections, skin grafts, uterine evacuations, etc.)	Abscess drainage, tendon repairs, washouts, reductions, etc.	Minor excision biopsies, wound care, large loop excision of transformation zone, etc.
Usual staffing per case	Non-specialist surgical provider, non-specialist anaesthetic provider, dedicated scrub nurse, dedicated floor nurse/s, midwife for caesarean sections	Non-specialist surgical provider, non-specialist anaesthetic provider as required, ad-hoc nursing support only	Non-specialist surgical provider only
Dedicated central sterile supply department	Yes	No	No
Operational hours	24 hours	24 hours	24 hours

Surgical service delivery

Patient demographics

Of the surgeries conducted at the facility, 97% were performed on female patients. The median patient age was 25 years (range 2-89), with 10% of patients being minors (18 years old or younger).

Surgical volume

The trends in the volume of surgical procedures are shown in Table 2. A total of 2616 individual surgical cases were performed over the seven-year period. The volume of cases increased over time, as visualised in the SPC analysis (Figure 1). The mean monthly theatre volume rose from 27 at the start of the study period to 41 at the end, representing an increase of mean monthly theatre volume of 52%. Although multiple favourable local factors were present over the study period, the inflection points in case volume are not associated with any specific intervention or event.

Surgical breadth

The surgical breadth, described in Table 2, was predominantly comprised of caesarean sections (CSs) but also included 180 uterine evacuations, 124 perineal repairs following birth trauma, and 28 skin grafts. A total of 25 unique procedures were conducted over the study period. There were 14 unique procedures performed in the first year, with an additional 11 unique procedures performed over the remainder of the study period.

Figure 1: SPC analysis of theatre volume in cases per month

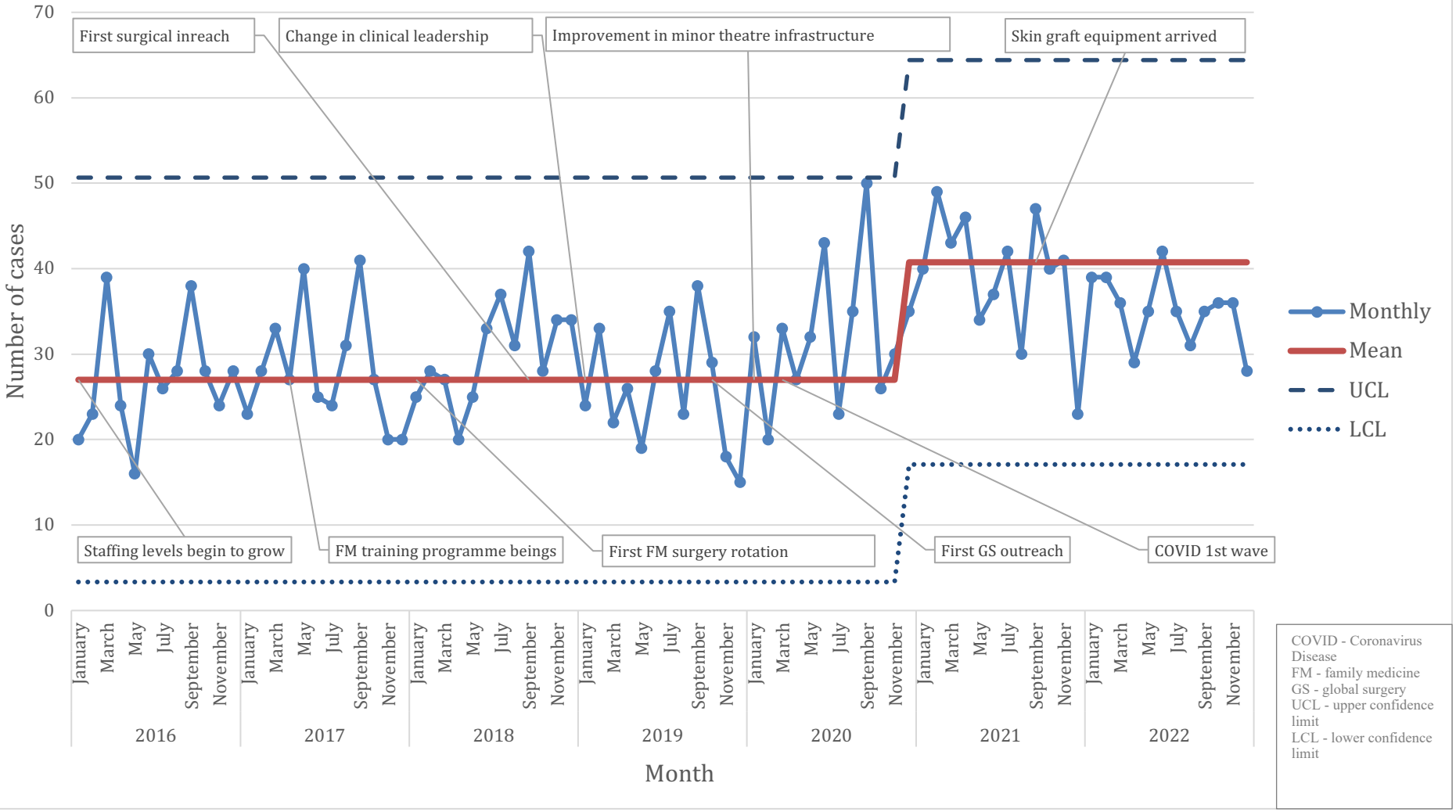


Table 2: Surgical procedure volume and breadth at Madwaleni District Hospital (2016-2022)

	2016	2017	2018	2019	2020	2021	2022	Total n (% of total)
General surgery	**7**	**2**	**3**	**1**	**3**	**12**	**15**	**43 (2)**
Skin graft±	*1*	*1*	*1*	*0*	*1*	*10*	*14*	*28 (1)*
Debridement	*0*	*1*	*2*	*1*	*2*	*0*	*1*	*7 (0)*
*Skin biopsy^*	*3*	*0*	*0*	*0*	*0*	*1*	*0*	*4 (0)*
*Abscess incision and drainage§^*	*2*	*0*	*0*	*0*	*0*	*1*	*0*	*3 (0)*
*Lymph node biopsy^*	*1*	*0*	*0*	*0*	*0*	*0*	*0*	*1 (0)*
Obstetrics and gynaecology	**306**	**326**	**345**	**306**	**379**	**455**	**400**	**2 517 (96)**
Caesarean section±	*254*	*281*	*295*	*271*	*326*	*380*	*337*	*2 144 (82)*
Evacuation of retained products of conception±	*32*	*21*	*21*	*20*	*17*	*42*	*27*	*180 (7)*
Perineal repair	*16*	*17*	*17*	*12*	*19*	*22*	*21*	*124 (5)*
Female sterilisation±	*0*	*2*	*10*	*1*	*3*	*0*	*1*	*17 (1)*
Removal of retained intrauterine contraceptive device	*0*	*0*	*0*	*2*	*7*	*2*	*5*	*16 (1)*
Manual removal of placenta	*2*	*2*	*2*	*0*	*3*	*1*	*2*	*12 (0)*
Laparotomy for ectopic pregnancy±	*0*	*3*	*0*	*0*	*1*	*1*	*2*	*7 (0)*
Repair of cervical tear	*2*	*0*	*0*	*0*	*0*	*3*	*1*	*6 (0)*
Laparotomy for postpartum haemorrhage	*0*	*0*	*0*	*0*	*2*	*1*	*2*	*5 (0)*
Examination under anaesthesia	*0*	*0*	*0*	*0*	*1*	*3*	*0*	*4 (0)*
*Marsupialisation of Bartholin's cyst^*	*0*	*0*	*0*	*0*	*0*	*0*	*2*	*2 (0)*
Orthopaedics	**8**	**8**	**14**	**1**	**3**	**1**	**0**	**35 (1)**
*Digit amputation^*	*3*	*4*	*11*	*1*	*1*	*0*	*0*	*20 (1)*
Lower limb amputation	*2*	*2*	*0*	*0*	*1*	*0*	*0*	*5 (0)*
*Tendon repair^*	*0*	*2*	*2*	*0*	*0*	*1*	*0*	*5 (0)*
*Reduction of long bone fracture±^*	*2*	*0*	*0*	*0*	*1*	*0*	*0*	*3 (0)*
*Irrigation and debridement of open fracture±^*	*1*	*0*	*1*	*0*	*0*	*0*	*0*	*2 (0)*
Urology	**3**	**3**	**2**	**2**	**1**	**4**	**6**	**21 (1)**
Hydrocelectomy±	*0*	*0*	*2*	*1*	*1*	*3*	*6*	*13 (0)*
Prostate biopsy	*3*	*3*	*0*	*0*	*0*	*0*	*0*	*6 (0)*
*Male circumcision§^*	*0*	*0*	*0*	*1*	*0*	*0*	*0*	*1 (0)*
Orchidectomy	*0*	*0*	*0*	*0*	*0*	*1*	*0*	*1 (0)*
Total surgical procedures n	**324**	**339**	**364**	**310**	**386**	**472**	**421**	**2616**
Total unique procedures	**14**	**12**	**11**	**9**	**15**	**15**	**13**	**25**
Procedures per 100,000 population per year* n	**331**	**349**	**378**	**324**	**407**	**502**	**452**	**391****

± Denotes DCP3 district hospital level procedure
^Denotes procedure no longer performed in operating theatre, and now typically performed in procedure room or outpatient department
§ Denotes DCP3 primary health centre level procedure
*** Population size retrospectively modelled on recent census data**[16]
**** Mean value over study period**

Surgical workforce

The staffing numbers, illustrated in Figure 2, increased over the study period. While the number of junior staff (clinical associates, community service medical officers and grade one medical officers) remained relatively static, the number of senior staff (grade two medical officers, family medicine registrars and family physicians) increased. This qualitative change in staff coincided with the introduction of the family medicine training programme. There was a statistically significant correlation between number of cases performed and the total number of doctors employed ($r=0.86$, $p=0.01$).

Table 3 shows the surgical volume per cadre per year, highlighting the relative contribution of different staff cadres to the surgical service. Family medicine registrars provided the broadest range of surgical procedures, averaging nine different procedures per clinician per year. Figure 3 shows family medicine registrars and family physicians conducted the most surgeries per clinician per year, performing significantly more surgeries than any other cadre ($p < 0.05$).

Figure 2: Surgical providers by cadre per year

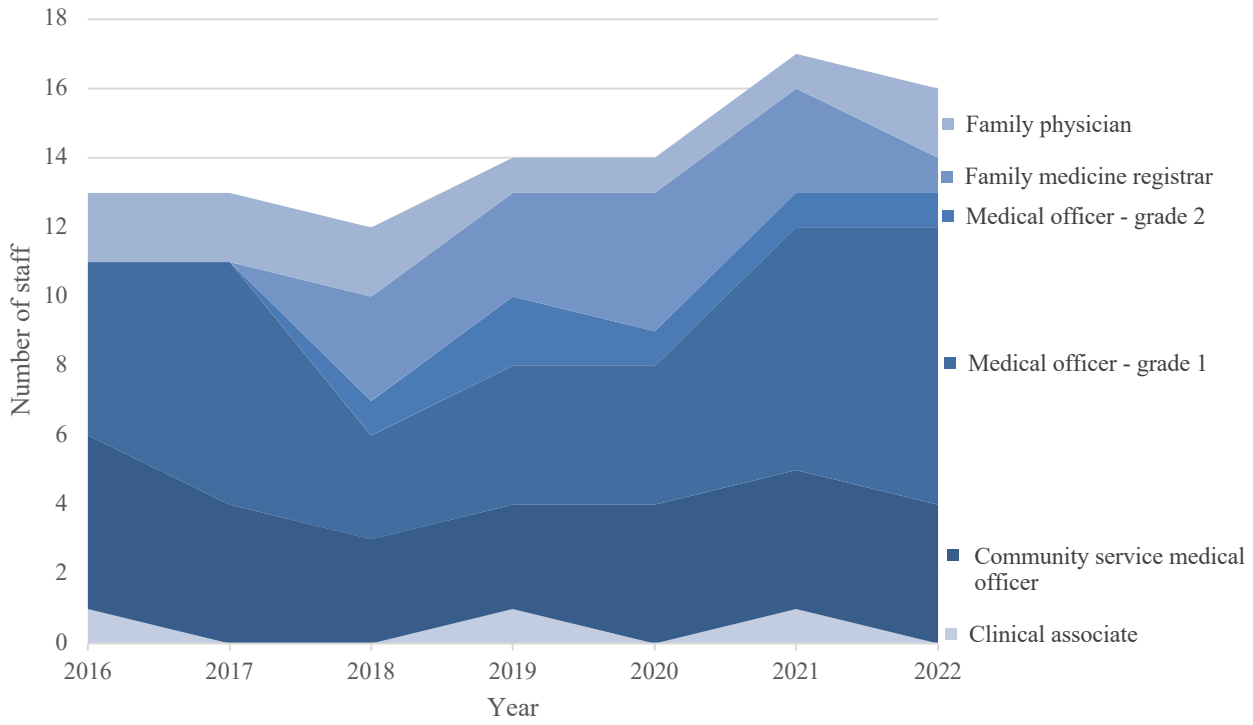
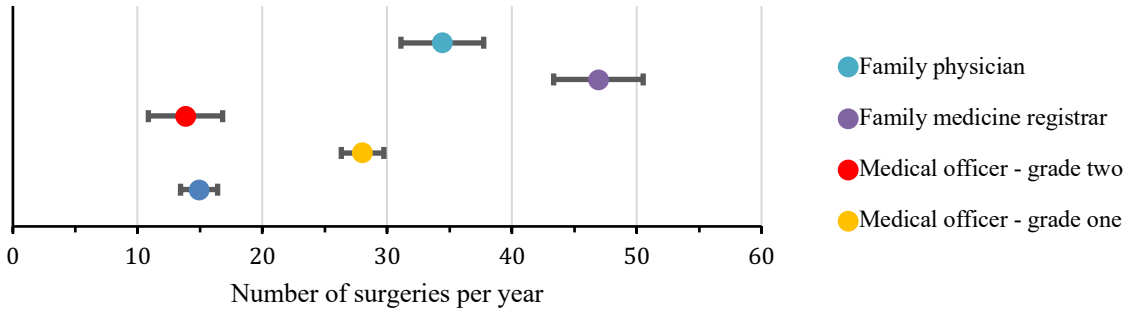


Table 3: Workload per professional cadre

	Staff years* n (% of total)	Cases performed n (% of total)	Mean cases per clinician per year (n)	Mean surgical repertoire per year (n)	% non-CS
Clinical associate	12 (11)	4 (0)	0.3	1	n/a#
Community service medical officer	27 (25)	388 (15)	14	4	15%
Medical officer – grade one	38 (35)	1037 (40)	27	7	17%
Medical officer – grade two	6 (6)	83 (3)	14	2	10%
Family medicine registrar	14 (13)	657 (25)	47	9	19%
Family physician	11 (10)	413 (16)	38	7	23%
Cadre not assigned^	n/a	34 (1)	n/a	n/a	38%
Total	**108 (100)**	**2616 (100)**	**24**	**13**	**18%**

*Staff years – number of clinicians of this cadre multiplied by number of years they were present during the study period
- not accredited to perform caesarean sections
^ - surgical provider not recorded in theatre logbook
Footnote on Professional Cadres
Clinical Associate – Mid-level, non-physician, healthcare worker
Community Service Medical Officer – Medical doctor completed 2 years internship post qualification
Medical Officer – grade one: Medical doctor with 0-5 years' experience post community service
Medical Officer – grade two: Medical doctor with 6-10 years' experience post community service
Family Medicine Registrar: Family physician in training
Family Physician: Specialist, fellow of the college of family physicians, South Africa

Figure 3: Mean annual case rates by cadre with 95% confidence intervals



Theatre usage

An average of 1.02 cases per day was recorded over the study period. The operating theatre, available 24 hours per day, was utilised for only 3% of the total available time. The median operative time for CS was 43 minutes, whilst the median operative time for all other cases was 31 minutes. Only six of the 24 non-CS procedures exhibited a longer median operating time than CSs. These procedures included wound debridement, skin grafts, laparotomy for ectopic pregnancies, orchidectomy, tendon repair and lower limb amputations.

Discussion

Our study presents a detailed analysis of the surgical outputs of a rural district hospital in South Africa, showcasing the expanding surgical repertoire provided by a team of generalist practitioners. Between 2016 and 2022, the surgical service expanded in both the volume of cases performed and surgical repertoire. While caesarean sections predominate (82% of surgical volume), a wide range of surgical care has been provided to patients aged 2 to 89 years old. These procedures include eight of the 28 procedures included in the World Bank's Disease Control Priority 3 (DCP3) district hospital surgical basket of care, with reports of another six DCP3 procedures performed routinely outside the theatre setting at this facility.[3] The growth in surgical services is associated with an increase in total staff numbers, with participants in the family medicine specialisation programme making a disproportionately large contribution to the service. The SPC analysis shows that no single intervention correlated directly with the increase in surgical capacity.

Capacity for change

Caesarean sections predominated this hospital's theatre output, a pattern consistent with other DHs in South Africa and Sub-Saharan Africa, where CSs account for 26%-82% of hospital procedures.[5,19–21] The competency required for CSs can predict competency for other surgical and anaesthetic procedures.[12] The availability of these skills, coupled with a low theatre utilisation rate, suggests significant capacity to expand the service further. A cross-sectional survey of DHs in SA reports that 58% of DHs can perform CSs[22], and theatre utilisation rates are thought to be low country-wide.[23] Thus, this capacity for expansion may also exist in other DHs across South Africa.

We have shown that at this district hospital, there is a significant positive correlation between the number of surgical providers and the volume of surgeries performed. This highlights the critical role of workforce capacity in meeting surgical demands. Exploring the role of clinical associates in expanding surgical services at district hospitals in South Africa could be an important step in addressing limited staffing capacities in these settings. Similar task-shifting models in other LMICs have successfully enabled mid-level healthcare workers, such as clinical associates, to provide safe and effective surgical care, improving access and outcomes in resource-constrained environments.[21,24]

Drivers of change

Staff

Staff numbers are widely acknowledged as critical to surgical service delivery.[2] Several studies suggest an important correlation between increased staff numbers and increased surgical volume.[25–28] However, in sub-Saharan Africa, an increase in staff does not always result in a proportional increase in surgical volume at district hospitals.[29] At our hospital more experienced staff and those enrolled in a training programme (family medicine registrars) made a disproportionately large contribution to the surgical output in our hospital.

In 2017, the health sciences faculty of the nearest university instituted a de-centralised family medicine specialisation programme, changing the training model by facilitating training at

district hospitals rather than urban university hospitals. These specialists in training are tied to their DHs for four years, creating continuity and building experience. They are incentivised to grow skill sets through logbooks and competency requirements, and the curriculum deliberately targets systems' improvement skill sets such as leadership and quality improvement methodology. In the study hospital, this cadre of staff members, plus the scaffolding and incentives for growth in their programme, have been influential in expanding surgical services.

Accessibility of the next procedure

There have been multiple local and international attempts to define a basket of surgical care appropriate for DHs, but because they represent a heterogeneous group of healthcare facilities with no standardised definition in terms of size or services offered, consensus on a set of surgical norms that is practical and implementable has proven elusive and sometimes contradictory.[3,9,11] An alternative approach to designing and rolling out a "basket of care" is required to realise incremental growth through the next single, achievable addition to the surgical repertoire.[29]

Lessons learned, and capacity gained with the introduction of a novel procedure can create a platform for systems towards the provision of ever more complex care. Choosing the next procedure to introduce requires balancing the capacity of the staff and facility against the impact of a particular procedure on patient-specific outcomes and the local disease burden. Contextual factors are important and may make specific procedures attractive targets despite their complexity, as occurred in another rural district hospital where a preponderance of hip joint arthritis drove the introduction of hip arthroplasty surgery.[31] At Madwaleni, the local team targeted accessible procedures such as tendon repairs, hydrocelectomies, and split-thickness skin grafts where local demand was significant, barriers to performing the cases were low, and access to the procedures at referral centres was limited. Surgical, anaesthesia, and nursing competence gained through performing these procedures has made the team more confident to perform higher complexity procedures. Locally, concerns remain around the total volume of certain procedures performed because they do not yet meet thresholds for the high volumes of repetition associated with improved patient outcomes for general practitioners over specialists.[32]

Other strategies for facilitating surgical repertoire expansion include supervised exposure to cases through specialist outreach to the rural facility or visits by DH staff to urban referral centres, retention of senior doctors in rural DHs, and short courses in surgery.[33,34] However, aiming to improve a system to provide an entire basket of care at a single DH may not be as achievable as providing a surgical basket of care within the wider referral system of a health district. One locally discussed proposal is to create DH centres of excellence for certain procedures (i.e. one DH specialises in burn care while another performs hernia repair). This would generate referral pathways between DHs that off-load tertiary referral hospitals and create the higher volumes required for improved competence.

Measuring change

Staff

District hospitals are essential vehicles for improving access to surgery.[2,3,35] In LMICs, these facilities are often staffed by non-specialist surgical providers.[2,5,29,36] Current benchmarks for measuring surgical provider density are focussed on the density of surgical specialists[2], but the density of surgically skilled generalists may be a more important predictor of access to surgical care at district hospitals. Data regarding the number of non-specialist surgical providers is not readily available in South Africa.

Procedures

National and international bodies have called for countries to collect and compile data on the number and types of surgical procedures conducted to inform policy and improvement initiatives. South Africa lacks a systematic method for gathering this information.[26,35] Data collected through the National Indicator Data Set database only includes surgical data for cataracts, caesarean sections, sterilisations (male and female), male circumcisions, and dental extractions.[37] The data for this study were extracted from a hardcopy surgical registry based in the Madwaleni operating theatre and completed by nurses. These registries are mandated and present in all theatres in DHs and thus offer an untapped data source. However, accessing this data is laborious, and data on the unmet surgical needs are excluded.

Limitations

Local clinicians report that many surgical procedures were performed outside of the operating theatre environment during the study period; thus, these data were not captured. Cases are performed in the casualty unit or outpatient consultation rooms for reasons of convenience and efficiency, and these include but are not limited to, orthopaedic reductions, tendon repairs, washout of open fractures, dental procedures, large loop excision of transformation zone for early cervical cancer, and biopsies. Thus, the total hospital surgical volume is likely higher than reported. Data on mode of anaesthesia was not routinely recorded in theatre register, but would have been an interesting variable to include. We also did not record quality of care measures, patient outcomes, or complication rates, meaning our understanding of the effect of the expansion of this district hospital surgical service is limited. Without robust mechanisms to describe the demand for surgery in this community, nor the rates of referral of patients to tertiary centres, we cannot comment on the unmet need or gaps within the current surgical service.

Conclusion

District hospitals are just one component of the broader surgical ecosystem, yet they are uniquely positioned to play a critical role in the delivery of emergency and essential surgical care in LMICs. Their geographical proximity to communities, the prevalence of functioning operating theatres, and the availability of appropriately skilled staff make them indispensable in bridging the gap between surgical need and access.

In South Africa, however, there is a lack of quality data to guide the expansion of surgical services at district hospitals. Key gaps include an understanding of the determinants of successful surgical service expansion and its impact on both communities and other clinical services in the already over-burdened district hospitals and referral facilities.

Our findings suggest that two key interventions – the introduction of a decentralised family medicine training programme, and the availability of an adequate and experienced staff complement – may have been key interventions for increasing surgical breadth and volume at this DH. With proper support, district hospitals have the potential to provide scalable, context-driven solutions to bridge the significant gap between met and unmet surgical needs in resource-limited settings.

Conflict of interests

Nil

Funding Sources

Nil

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Appendices

Appendix A: WHO surgical assessment tool for Madwaleni District Hospital

WHO SURGICAL ASSESSMENT TOOL

GENERAL QUESTIONS	
Country:	South Africa
Name of health care facility:	Madwaleni District Hospital
Address of health care facility:	Nkonya Rd, Elliotdale
Phone number of health care facility:	
Date of data collection (dd/mm/yyyy):	31-12-2022
Name and professional title of staff filling out form:	Dr Jessica Westwood (medical officer)
Contact information of staff completing this assessment (email):	dr.jessica.westwood@gmail.com
Level of facility being evaluated	☐ Health Centre/Clinic ☑ District/Rural Hospital ☐ Provincial/Secondary Hospital ☐ Tertiary/Teaching Hospital
Type of facility being evaluated	☑ Public ☐ Private ☐ NGO ☐ Mission ☐ Other

Facility Characteristics	
Total number of admissions in a year	# ± 3000
Total number of outpatients seen in a year	# ± 20 000
Total number of hospital beds	# 180
Total number of surgical beds	# 48
Total number of functioning operating rooms (major and minor)	# 2
Total number of post-anaesthesia care beds	# 0
Total number of advanced care/ICU beds	# 0
Total number of functional ventilators in the ICU	# n/a
Access and referral systems:	
What is the population served by this facility?	# 100 000
What percentage of your patients can reach the hospital within 2 hours of travel?	☐ 0 ☐ 1-25% ☐ 26-50% ☐ 51-75% ☑ 76-99% ☐ 100%
What is the number of patients that you refer for surgical intervention to a higher level facility per year	# ± 700

INFRASTRUCTURE				
General Infrastructure - **How often is this item available and functional? Choose** 0 - Unavailable for Unavailable (**NOT AVAILABLE FOR ANYONE** who needs it); 1 - Inadequate (available to **LESS THAN HALF** of those who need it); 2 - Limited (available to **MORE THAN HALF**, but not to everyone who needs it); or 3 - Adequate (**PRESENT, AVAILIBLE** to almost everyone in need, and used when needed).	Unavailable (0)	Inadequate (1)	Limited (2)	Adequate (3)
Dedicated 24 hour Emergency Unit	☐ 0	☐ 1	☐ 2	☑ 3
Electricity/operational power generator	☐ 0	☐ 1	☑ 2	☐ 3
Running water	☐ 0	☐ 1	☑ 2	☐ 3
Internet	☐ 0	☐ 1	☐ 2	☑ 3
Oxygen	☐ 0	☐ 1	☐ 2	☑ 3
Pharmacy-**How often is this available for surgery?**				
Inhalational general anaesthesia	☐ 0	☐ 1	☐ 2	☑ 3
IV sedation anaesthesia (Ketamine, Midazolam, Propofol)	☐ 0	☐ 1	☐ 2	☑ 3
Spinal anaesthesia	☐ 0	☐ 1	☐ 2	☑ 3
Regional anaesthesia available	☐ 0	☐ 1	☐ 2	☑ 3
Peri-operative antibiotics	☐ 0	☐ 1	☐ 2	☑ 3
IV fluids	☐ 0	☐ 1	☐ 2	☑ 3
Muscle relaxants/paralytics	☐ 0	☐ 1	☑ 2	☐ 3
Sedatives	☐ 0	☐ 1	☐ 2	☑ 3
Vasopressors	☐ 0	☐ 1	☐ 2	☑ 3
Post-operative narcotics	☐ 0	☐ 1	☐ 2	☑ 3

1

	Unavailable (0)	Inadequate (1)	Limited (2)	Adequate (3)
Radiology				
X-ray machine	☐ 0	☐ 1	☑ 2	☐ 3
Ultrasound	☐ 0	☐ 1	☐ 2	☑ 3
Fluoroscopy	☑ 0	☐ 1	☐ 2	☐ 3
CT scanner	☑ 0	☐ 1	☐ 2	☐ 3
MRI scanner	☑ 0	☐ 1	☐ 2	☐ 3
Blood Supply				
How often are you able to administer a blood transfusion within 2 hours	☐ 0	☐ 1	☑ 2	☐ 3
Laboratory				
Haemoglobin testing	☐ 0	☐ 1	☐ 2	☑ 3
Full blood count testing	☐ 0	☐ 1	☐ 2	☑ 3
Coagulation profile testing (PT, PTT, BT, INR)	☐ 0	☐ 1	☑ 2	☐ 3
Electrolytes testing	☐ 0	☐ 1	☐ 2	☑ 3
BUN and creatinine testing	☐ 0	☐ 1	☐ 2	☑ 3
Infectious panel testing (HIV, hepatitis virus, others)	☐ 0	☐ 1	☐ 2	☑ 3
Cardiac marker testing	☐ 0	☑ 1	☐ 2	☐ 3
Cross matching for blood and blood products	☐ 0	☐ 1	☐ 2	☑ 3

SERVICE DELIVERY

Rate adequacy as above.
0 - Unavailable for Unavailable (**NOT AVAILABLE FOR ANYONE** who needs it);
1 - Inadequate (available to **LESS THAN HALF** of those who need it);
2 - Limited (available to **MORE THAN HALF**, but not to everyone who needs it); or
3 - Adequate (**PRESENT, AVAILIBLE** to almost everyone in need, and used when needed).Adequate (**PRESENT, AVAILIBLE** to almost everyone in need, and used when needed).

If less than adequate (rating 0, 1, or 2) then identify the barriers to access---------->

Access Barriers
(Check all that apply)
Infrastructure - physical space, equipment or materials.
Absent - has never has been present
Broken –resources present, but broken
Personnel - resource, service or function available, and staff trained, but limited availability at times (eg, night, weekend or holiday)
Training - No staff trained in using resource or performing function
Stock out - cannot be procured, or required equipment or supplies out of stock often due to poor stock management practices or procurement failures
User fees - available, but out-of-pocket payment requirement prevents delivery for some
Other - Other factors

	Total number performed per year	Rate (0-3) 0-Unavailable 1-Inadequate 2-Limited 3-Adequate	Infrastructure	Absent	Broken	Personnel	Training	Stock out	User fees	Other
Procedures- Minor										
1. Normal delivery	# 1080	3								
2. Suturing laceration	# 2000	3								
3. Drainage of abscess	# 200	3								
4. Male circumcision	# 30	3								
5. Management of non-displaced fractures	# 1000	3								
6. Wound debridement	# 800	3								
7. Removal of foreign body (throat/eye/ear/nose)	# 300	3								
8. Biopsy (lymph node, mass, other)	# 300	3								

Procedures – Major												
Obstetrics, gynaecology, family planning												
1. Caesarean birth	#337	3										
2. Vacuum extraction/forceps delivery	# 50	3										
3. Ectopic pregnancy	# 2	2				✓	✓					
4. Manual vacuum aspiration and dilation and curettage	# 27	3										
5. Tubal ligation	# 1	3										
6. Vasectomy	# 0	2					✓					
7. Hysterectomy for uterine rupture, intractable postpartum haemorrhage, or elective	# 0	2				✓	✓					
8. Inspection with acetic acid, cryotherapy for cervical lesions	# 80	3										
General Surgery												
9. Repair of intestinal perforations	# 20	3										
10. Appendectomy	# 0	0	✓	✓		✓	✓					
11. Bowel obstruction	# 0	0	✓	✓		✓	✓					
12. Colostomy/ileostomy	# 0	0	✓	✓		✓	✓					
13. Gallbladder disease	# 0	0	✓	✓		✓	✓					
14. Hernia, including incarceration	# 0	0	✓	✓		✓	✓					
15. Hydrocelectomy	# 6	3										
16. Relief of urinary obstruction: Catheterization or suprapubic cystostomy	# 30	3										
Injury												
17. Resuscitation with advanced life support measures, including surgical airway	# 50	3										
18. Tube thoracostomy	# 80	3										
19. Trauma laparotomy	# 0	0	✓	✓		✓	✓					
20. Open reduction and internal fixation	# 0	0	✓	✓		✓	✓					
21. Irrigation and debridement of open fractures	# 50	3										
22. Placement of external fixator	# 0	0	✓	✓		✓	✓					
23. Escharotomy/fasciotomy /contracture release	# 0	0	✓	✓		✓	✓					
24. Amputations	# 0	0	✓	✓		✓	✓					
25. Skin grafting	# 14	3										
26. Burr hole	# 0	0	✓	✓		✓	✓					
27. Craniotomy, not burr hole	# 0	0	✓	✓		✓	✓					
Non-trauma orthopaedic												
28. Drainage of septic arthritis	# 0	0	✓	✓		✓	✓					
29. Debridement of osteomyelitis	# 0	0	✓	✓		✓	✓					
Procedures - Advanced												
30. Repair obstetric fistula	# 0	0	✓	✓		✓	✓					
31. Repair of cleft lip and palate	# 0	0	✓	✓		✓	✓					

32. Repair of club foot	# 10	3										
33. Shunt/ETV/CPC for hydrocephalus	# 0	0	✓	✓			✓					
34. Repair of anorectal malformation and Hirschsprung's Disease	# 0	0	✓	✓			✓					
35. Cataract extraction and insertion of intraocular lens	# 0	0	✓	✓			✓					
36. Eyelid surgery for trachoma	# 0	0	✓	✓		✓	✓					

Surgical Volume	
Number of laparotomies performed last year	# 4
Number of C-sections performed last year	# 337
Number of open fracture repairs performed last year	# 0
Total number of surgeries performed last year	# 421
Total number of paediatric surgeries (<15 years) performed last year	# 1
Percent of cases that were emergency/urgent (non-elective) cases	% 50
Quality and Safety	
Average number of post-operative, in-hospital deaths per year	# 0
WHO surgical safety checklist utilization in the operating rooms	☐ 0 ☐ 1 ☐ 2 ☒ 3
Pulse oximetry utilization in the operating rooms	☐ 0 ☐ 1 ☐ 2 ☒ 3
Hospital participation in quality improvement projects, such as mortality and morbidity conferences	☐ Never ☐ Monthly ☒ Quarterly ☐ Yearly

Operating Room Equipment and Supplies – How often are the following equipment available and functional for surgery?

	Rating (0-3)	Infrastructure	Absent	Broken	Personnel	Training	Stock out	User fees	Other
Functional anaesthesia machines	2		✓	✓					
Adult oropharyngeal airway	2						✓		
Paediatric oropharyngeal airway	2						✓		
Adult endotracheal tube	2						✓		
Paediatric endotracheal tube	2						✓		
Adult laryngoscope	2			✓					
Paediatric laryngoscope	2			✓					
Adult facemask bag valve	3								
Paediatric facemask bag valve	3								
Difficult airway kit (LMA)	3								
Adult Magill forceps	3								
Paediatric Magill forceps	3								
Blood pressure monitor or cuff	3								
Pulse oximetry	3								
Stethoscope	3								
Suction apparatus	3								
Thermometer	3								
Nasogastric Tube	3								
Light source	3								
Chest tube	3								
Electrocautery	3								
Autoclave/Sterilizer	2			✓					
Forceps	3								
Syringes with needles	3								
Scalpel	3								
Scissors	3								
Needle holder	3								
Retractor	3								
Sterile gloves	3								
Urinary catheters	3								
Tourniquet	3								

	Rating (0-3)	Infrastructure	Absent	Broken	Personnel	Training	Stock out	User fees	Other
Face masks	3								
Gowns	3								
Disinfectant hand wash	2						✓		
Sterilizing skin prep	2						✓		
Eye protection	1		✓				✓		
Sharps disposal container	3								
Non-sterile Examination Gloves	3								
Sutures	2						✓		

WORKFORCE

Surgeon/Anaesthesiologist/Obstetrician/Provider Density

Providers	**Full time**	**Part time**
Number of qualified surgeons	# 0	# 0
Number of qualified paediatric surgeons	# 0	# 0
Number of qualified OB/GYNs	# 0	# 0
Number of qualified anaesthesiologists	# 0	# 0
Number of general doctors providing surgery	# 16	# 1
Number of general doctors providing C-sections	# 15	# 1
Number of general doctors providing anaesthesia	# 16	# 1
Number of non-physicians providing surgery	# 1	# 0
Number of non-physicians providing C-sections	# 0	# 0
Number of non-physicians providing anaesthesia	# 0	# 0
Number of midwives	# 12	# 0
Number of nurses on the surgical wards	# 16	# 0
Number of qualified radiologists	# 3	# 0
Number of qualified pathologists	# 0	# 0
Number of qualified pharmacists	# 3	# 0
Number of qualified biomedical technicians	# 0	# 0

Work Force Availability	Unavailable (0)	Inadequate (1)	Limited (2)	Adequate (3)
Surgical provider availability	☐ 0	☐ 1	☐ 2	☒ 3
Obstetrical /gynaecology provider	☐ 0	☐ 1	☐ 1	☒ 3
Anaesthesia provider availability	☐ 0	☐ 1	☐ 1	☒ 3

Continuing Medical Education

How often do you offer continuing medical education to your staff each year?	☐ Never ☒ Monthly ☐ Quarterly ☐ Yearly

FINANCING	
Health financing and accounting	
Percentage of patients with health insurance	☒0 ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-99% ☐ 100%
Budget Allocation	
Total annual hospital budget (in USD)	$ unsure
Annual hospital budget allotted to surgery and anaesthesia (in USD)	☒0 ☐ 1-25% ☐ 26-50% ☐ 51-75% ☐ 76-99% ☐ 100%
Cost-**(US dollars)**	
What is the average out-of-pocket cost to a patient for a C-section?	$ 0
What is the average out-of-pocket cost to a patient for an open fracture repair?	$ n/a
What is the average out-of-pocket cost to a patient for a laparotomy?	$ 0
What is the average out-of-pocket cost to a patient for a CBC?	$ 0
What is the average out-of-pocket cost to a patient for a Chest X-ray?	$ 0
What is the average out-of-pocket cost to a patient for surgery-associated lodging per day?	$ 0
What is the average out-of-pocket cost for patient and family transportation per surgery/hospital stay?	$ 4
What is the average out-of-pocket cost to a patient for surgery-associated medication per surgery/hospital stay?	$ 0
What is the average out-of-pocket cost to a patient for other necessities (e.g. laundry/food) per surgery/hospital stay?	$ 0

INFORMATION MANAGEMENT	
Information Systems	
What is the method of record keeping in your hospital?	☐ Electronic ☑ Paper ☐ Both ☐ None
Are there personnel in charge of maintaining medical records?	☒ Yes ☐ No
Are charts accessible across multiple visits for the same patient?	☒ Yes ☐ No
How often is data prospectively collected for patient outcomes, such as surgical site infection, post op stroke, DVT, etc.?	☐ 0 ☑ 1 ☐ 2 ☐ 3
How often is data prospectively collected for post-operative mortality rate?	☐ 0 ☑ 1 ☐ 2 ☐ 3
How often are you required to report information to the Ministry of Health or an equivalent agency?	☐ Never ☑ Monthly ☐ Quarterly ☐ Yearly
Do you use telemedicine?	☐ Yes ☑ No
Research Agenda	
How many ongoing research projects does the hospital have?	# 4
How many ongoing research projects does the department of surgery have?	# 1
How many ongoing research projects does the department of OB/GYN have?	# 1
How many ongoing research projects does the department of anaesthesia have?	# 0

Appendix B: Research protocol

A descriptive study of a surgical service in a rural district hospital in the Eastern Cape

Abstract

Background: One third of the global burden of disease requires surgical, obstetric or anaesthesia care. However, 90% of people living in low- and middle-income countries (LMICs) are unable to access this care or face catastrophic economic consequences to do so. District hospitals have been identified as an important entity in improving access to surgical care in order to reduce the gap between disease burden and service provision. But limited literature describes surgical care at district hospitals in detail.

Aim: The aim of this study is to evaluate the extent of surgical services offered at a rural district hospital.

Methods: Retrospective data will be collected of theatre cases performed. The descriptive data will illustrate the quantity, diversity and fluctuation in a rural district hospital's theatre service over a seven year period.

Impact: The impact of this project is to create an overview of the surgical service currently being offered in a rural district hospital, and what services are missing from an essential package of surgical care, with findings that are potentially transferable to other district hospitals. These findings will highlight areas of focus for clinical, managerial and financial input, resulting in an opportunity for advocacy for improved access to surgical services for South Africa's rural populations.

Background and Significance

One third of the global burden of disease requires surgical, obstetric or anaesthesia care.[1] However, 90% of people living in low- and middle-income countries (LMICs) are unable to access this care or face catastrophic economic consequences to do so.[2] The COVID-19 pandemic has put further strains on a surgical service which was backlogged.[3] Improving rural district hospital surgical capacity is a possible solution proposed by international bodies such as the WHO and the Lancet Commission on Global Surgery.[2] Offering essential surgical services at district hospitals decentralises care and reduces the distance communities must travel to access care.

District hospitals represent a heterogenous category of healthcare institutions, with widely varied staffing, infrastructure, and capacity to deliver the package of surgical care suggested by global bodies and local regulators as necessary or appropriate. In South Africa, limited data describe the readiness of these hospitals to provide surgical care,[4] while robust data describe how a lack of capacity to perform essential emergency surgical, obstetric, and anaesthesia care results in unnecessary harm and deaths of otherwise curable patients.[5–7]

Lists of the type of surgical care that should be offered at district hospitals have been proposed, [8,9] and several African countries have either published National Surgical, Obstetric and Anaesthesia Plans, or are busy drafting them.[10] However, a gap remains between these descriptions of ideal services and what actually occurs. Further, there is robust evidence that

directive style interventions that impose practice guidelines as a top-down attempt to change health care provider behaviour are less likely to be effective than those that combine group problem solving mechanisms with training initiatives.[11] An in-depth description of what is possible in a relatively successful rural district hospital will provide a more realistic model on which to base future policy, and also provide insights into the mechanisms that have supported growth in surgical care.

We aim to evaluate the surgical services offered at a rural district hospital that reports progress in recent years. To do this, we will quantify the scope and volume of procedures undertaken. This will be collected both retrospectively.

We hypothesise that our study hospital has increased the number and volume of operations provided over the last seven years but that the unmet need for surgical care remains significant.

Method

Instrument and Justification

The primary data collection for this study will consist of a theatre logbook audit. This descriptive data will be collected from the theatre register at Madwaleni Hospital. The information in this register is captured by theatre nursing staff during every theatre case. The data will be collected retrospectively for a period of seven years (2016 -2022). All cases over this time period will be included in the data collection. This seven-year period was chosen in order to show the fluctuation in case numbers and the diversity of cases over time. The data will be inputted into Microsoft Excel without any patient identifiers.

Using the theatre logbook as source data avoids the need to locate and review individual folders which is logistically challenging and often unreliable. While the theatre logbooks offer only a limited dataset, the accuracy and availability of these data offer advantages.

Outcome measures

We will describe the volume and breadth of surgical services through retrospective audit of the following data points available in the theatre logbooks:

Date of procedure
Patient medical records number
Age
Gender
Ward
Surgeon
Assistant surgeon
Anaesthetist
Scrub nurse
Start time
Finish time
Estimated blood loss
Procedure
Indication
Additional procedures (e.g. bilateral tubal ligation/intrauterine contraceptive device implantation)

The Surgeon's years of experience since qualification, at the time of the operation, will be recorded, plus their staff category which would be one of: community service officer, medical officer, registrar, or specialist family physician.

Data collection and handling
Data will be stored in a password protected google drive folder, with access only available to a limited number of investigators. All patient data will be de-identified before reporting.

Sample
There are no sample size calculations. This service improvement project will collect service level data on all included patients.

Analysis
Continuous variables will be tested for normality using histograms and exploratory analysis and expressed using means (standard deviations) or medians (interquartile ranges) depending on their distributions, while categorical variables will be expressed as frequencies and percentages.

Group comparisons of continuous variables will be analysed using either parametric tests (two-sample t-test) or non-parametric tests (Mann-Whitney U test) depending on the distribution. Chi-square test or Fisher's Exact tests will be used to test for associations between categorical variables. The level of significance is set at p=0.05. All statistical analysis will be performed using Stata[13].

Comparisons of volume and breadth of surgery will be made over the epoch of the collected data to test for significant changes in the surgical service. Where applicable outcome variables such as blood loss and case duration will be compared across clinicians of different experience levels to evaluate the impact of experience on theatre utilisation and patient outcomes.

Before analysis, data will be reviewed for missing data and outliers. Missing data will be accessed from patient folders where possible.

Impact
The impact of this project is to create a comprehensive overview of the surgical service currently being offered in a rural district hospital, and what services are missing from an essential package of surgical care, highlighting areas of focus for clinical, managerial and financial input. We anticipate that our findings will be transferable to other rural hospitals.

Further, the findings from this study will complement the findings of the proposed HREC 071/2023 study (under HREC review): Exploring the implications of improving access to safe essential surgery in rural South African. Comparison of the quantitative service level data with the qualitative findings of HREC 071/2023 will provide a rich picture of how and why the host hospital has managed to change the service they provide their patients, and what this has meant for the hospital healthcare worker teams.

Ethics
This project will be conducted in line with the principles of Good Clinical Practice and the declaration of Helsinki[14].

The project will adhere to the ethical considerations of beneficence, autonomy, non-maleficence, justice:

Beneficence - Our intention is to improve understanding of the rural health surgical ecosystem, in order to design and implement changes that improve the health and lives of rural people.

Autonomy - As this is a descriptive study involving medical records - there will be no direct patient interactions. All data will be de-identified and confidential.

Non-maleficence - As this project is descriptive, we do not believe we will cause harm to the patients or the standard of their healthcare.

Justice - This project focuses on bringing benefit to a marginalised rural community, and other similar rural communities thus upholding the ethical principle of distributive justice.

All data will be anonymised at collection, before analysis and publication, and stored securely in the cloud via password protection, with access limited to a small pool of investigators only.

Informed Consent

This study proposes the collection of routine clinical data only. The data are already collected in various forms including theatre logbooks, hospital statistics that are reported to the relevant provincial health authority, ambulance logs, and inpatient notes. By consolidating these disparate data into a single database we will enable the local clinician and leadership teams to understand their system, and measure the impact of any changes they make.

Inclusion of retrospective data avoids the risk of patient harm. Since proposed prospective data is already collected during routine care, this process is also very unlikely to influence patient care adversely.

Lastly, attempting to obtain patient informed consent for inclusion in this study is likely to place an undue burden on the clinician teams involved, and would risk delaying or adversely affecting the quality of care delivered in an already stretched and under-resourced setting. Obtaining informed consent would, therefore, render this audit and improvement work impossible.

We thus believe that the risk to patient care and confidentiality is negligible, and that a waiver of informed consent would be appropriate. We do, however, welcome the ethical oversight of this project from HREC implicit in the review and annual renewal process. We believe this request to be in alignment with international norms regarding patient and healthcare worker consent for service level audit and improvement projects that pose minimal risk[15] and with UCT HREC's guidance on waivers of informed consent.

Timeline

We aim to begin prospective data capture early in March 2023, ending 12 months later - end of February 2024. Retrospective data will also be collected during this time. Analysis and publication will be complete by June 2024.

Budget

This work is unfunded.

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Appendix C: Ethics approval – Eastern Cape Department of Health

Province of the
EASTERN CAPE
HEALTH

Enquiries: Yvonne Gixela TEL: 043 605 4540/4518

Email: ncebagixela22@gmail.com

Date: 20 July 2023

A descriptive study of a surgical service in a rural district hospital in the Eastern Cape. (EC_202307_011)

Dear Dr R. Duys and Dr J. Westwood

The department would like to inform you that your application for the above mentioned 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 Research Ethics Committee.

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 COMMITTE

2030 NDP

TOGETHER, MOVING THE HEALTH SYSTEM FORWARD

Appendix D: Ethics approval – University of Cape Town

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room 45 E-52-E-Floor- Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: hrec-submissions@uct.ac.za
Website: www.health.uct.ac.za/home/human-research-ethics

11 July 2023

HREC REF: 158/2023

Dr R Duys
Department of Anaesthesia & Perioperative Medicine
D-23 NGSH
Email: rowanduys@gmail.com
Student: Jess.westwood@icloud.com

Dear Dr Duys

PROJECT TITLE: A DESCRIPTIVE STUDY OF A SURGICAL SERVICE IN A RURAL DISTRICT HOSPITAL IN THE EASTERN CAPE-
(MSC CANDIDATE-JESSICA WESTWOOD)

Thank you for your response letter addressing the issues raised by the Faculty of Health Sciences Human Research Ethics Committee (HREC).

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study, subject to DoH approval.

Approval is granted for one year until the 30 July 2024.

You are required to submit a progress report form, using the standardised Annual Report Form (FHS016) if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledges that the student: Jessica Westwood will also be involved in this study.

Please quote HREC REF 158/2023 in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637. Institutional Review Board (IRB) number: IRB00001938 NHREC-registration number: REC-210208-007

HREC/ref 158.2023

Appendix E: Submission guidelines – South African Family Practice

Submission status	open
Word limit	7000 words (excluding the abstract, tables, figures, graphs, and references)
Abstract	maximum: 250 words requires structural headings: Background, Methods, Results, Conclusion and Contribution
Main text	requires structural headings, refer to the full structure 'Ethical considerations' is a sub-section in the manuscript and must include: • Name of the ethical review committee • Study approval number • Manner of consent (written, oral) for human participants • Description of measures taken to maintain the confidentiality of data • If the study was not human or animal research or the study was determined to be non-human subjects research or exempt, the authors must provide a statement with those details in this section.
References	40 or less, adhere to the **Vancouver referencing style**
Tables, figures and graphs	7 or less, adhere to the Illustrations requirements found in the AOSIS House style guide
Formatting requirements	apply the guidelines located on the **Formatting requirements page** and the **AOSIS house style guide**
Compulsory supplementary file(s)	the **Authorship, disclosure statements, copyright, and license agreement form**, **Ethical Clearance/Waiver Documentation** and any other relevant form applicable to your submission
Optional supplementary file	the **CRISP Compliance checklist**
Ethical clearance/waiver documentation	evidence of ethical clearance for the study, such as the study approval letter or certificate from the Institutional Review Board (IRB), a waiver from the IRB et cetera

Original Research Article full structure

Title: The article's full title should contain a maximum of 95 characters (including spaces).

Abstract: The abstract, written in English, should be no longer than 250 words and must be written in the past tense. The abstract should give a succinct account of the objectives, methods, results and significance of the matter. The structured abstract for an Original Research article should consist of five paragraphs labelled Background, Methods, Results, Conclusion and Contribution.

- Background: Summarise the social value (importance, relevance) and scientific value (knowledge gap) that your study addresses.

- Methods: Clearly express the basic design of the study, and name or briefly describe the methods used without going into excessive detail.
- Results: State the main findings.
- Conclusion: State your conclusion and any key implications or recommendations.
- Contribution: What key insights into the research results and its future function are revealed? How do these insights link to the focus and scope of the journal? It should be a concise statement of the primary contribution of the manuscript; and how it fits within the scope of the journal.

Do not cite references and do not use abbreviations excessively in the abstract.

Introduction: The introduction must contain your argument for the social and scientific value of the study, as well as the aim and objectives:

- Social value: The first part of the introduction should make a clear and logical argument for the importance or relevance of the study. Your argument should be supported by the use of evidence from the literature.
- Scientific value: The second part of the introduction should make a clear and logical argument for the originality of the study. This should include a summary of what is already known about the research question or specific topic and should clarify the knowledge gap that this study will address. Your argument should be supported by the use of evidence from the literature.
- Conceptual framework: In some research articles it will also be important to describe the underlying theoretical basis for the research and how these theories are linked together in a conceptual framework. The theoretical evidence used to construct the conceptual framework should be referenced from the literature.
- Aim and objectives: The introduction should conclude with a clear summary of the aim and objectives of this study.

Research methods and design: This must address the following:

- Study design: An outline of the type of study design.
- Setting: A description of the setting for the study; for example, the type of community from which the participants came or the nature of the health system and services in which the study is conducted.
- Study population and sampling strategy: Describe the study population and any inclusion or exclusion criteria. Describe the intended sample size and your sample size calculation or justification. Describe the sampling strategy used. Describe in practical terms how this was implemented.
- Intervention (if appropriate): If there were intervention and comparison groups, describe the intervention in detail and what happened to the comparison groups.
- Data collection: Define the data collection tools that were used and their validity. Describe in practical terms how data were collected and any key issues involved, e.g. language barriers.
- Data analysis: Describe how data were captured, checked and cleaned. Describe the analysis process, for example, the statistical tests used or steps followed in qualitative data analysis.
- Ethical considerations: Approval must have been obtained for all studies from the author's institution or other relevant ethics committee and the institution’s name and permit numbers should be stated here.

Results: Present the results of your study in a logical sequence that addresses the aim and objectives of your study. Use tables and figures as required to present your findings. Use quotations as required to establish your interpretation of qualitative data. All units should

conform to the **SI convention** and be abbreviated accordingly. Metric units and their international symbols are used throughout, as is the decimal point (not the decimal comma).

Discussion: The discussion section should address the following four elements:

- Key findings: Summarise the key findings without reiterating details of the results.
- Discussion of key findings: Explain how the key findings relate to previous research or to existing knowledge, practice or policy.
- Strengths and limitations: Describe the strengths and limitations of your methods and what the reader should take into account when interpreting your results.
- Implications or recommendations: State the implications of your study or recommendations for future research (questions that remain unanswered), policy or practice. Make sure that the recommendations flow directly from your findings.

Conclusion: Provide a brief conclusion that summarises the results and their meaning or significance in relation to each objective of the study.

Acknowledgements: Those who contributed to the work but do not meet our authorship criteria should be listed in the Acknowledgments with a description of the contribution. Authors are responsible for ensuring that anyone named in the Acknowledgments agrees to be named. Refer to the acknowledgement structure guide on our *Formatting Requirements* page.

Also provide the following, each under their own heading:

- Competing interests: This section should list specific competing interests associated with any of the authors. If authors declare that no competing interests exist, the article will include a statement to this effect: *The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.* Read our **policy on competing interests**.
- Author contributions: All authors must meet the criteria for authorship as outlined in the **authorship** policy and **author contribution** statement policies.
- Funding: Provide information on funding if relevant
- Data availability: All research articles are encouraged to have a data availability statement.
- Disclaimer: A statement that the views expressed in the submitted article are his or her own and not an official position of the institution or funder.

References: Authors should provide direct references to original research sources whenever possible. References should not be used by authors, editors, or peer reviewers to promote self-interests. Refer to the journal referencing style downloadable on our *Formatting Requirements* page.

Appendix F: STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Reported on page number
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	48
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	48
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	49-50
Objectives	3	State specific objectives, including any prespecified hypotheses	49-50
Methods			
Study design	4	Present key elements of study design early in the paper	50
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	50
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	50
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	n/a
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	50
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	50
Bias	9	Describe any efforts to address potential sources of bias	50
Study size	10	Explain how the study size was arrived at	50
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	50
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	50
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	50
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	n/a
		(*e*) Describe any sensitivity analyses	n/a
Results			

Participants	13	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	52
		(b) Give reasons for non-participation at each stage	n/a
		(c) Consider use of a flow diagram	n/a
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	52
		(b) Indicate number of participants with missing data for each variable of interest	n/a
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	n/a
Outcome data	15	*Cohort study*—Report numbers of outcome events or summary measures over time	n/a
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	n/a
		Cross-sectional study—Report numbers of outcome events or summary measures	n/a
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	55-56
		(*b*) Report category boundaries when continuous variables were categorized	n/a
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	n/a
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	n/a
Discussion			
Key results	18	Summarise key results with reference to study objectives	57
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	59
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	59
Generalisability	21	Discuss the generalisability (external validity) of the study results	59
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	60