

FACILITY-BASED CAPACITY ASSESSMENT OF EMERGENCY CARE SERVICES IN PUBLIC HOSPITALS IN ZAMBIA

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ABBREVIATIONS AND ACRONYMS

AFEM	African Federation for Emergency Medicine
AIDS	Acquired immuno deficiency syndrome
ECAT	Emergency Care Assessment Tool
HIV	Human Immunodeficiency Virus
LMIC	Low and Middle Income Countries
LIC	Low Income Counties
MoH	Ministry of Health
MCDCH	Ministry of Community Development and Child Health
NCD	Non-Communicable Diseases
SDG	Sustainable Development Goals
TB	Tuberculosis
UN	United Nations
WHO	World Health Organization
ZDF	Zambia Defence Force

ABSTRACT

In sub-Saharan Africa, the shift in disease burden from infections to non-communicable disease and injury highlights the need for effective and efficient emergency care. Despite this, emergency care is a neglected sector of the health system in most low and middle-income countries. Funding and resource allocations are often small and have little impact on the development of emergency care systems, and provision of emergency care is therefore frequently left to under-trained and/or under-prepared nurses or clinical officers. In order to develop effective emergency care systems, one must first identify strengths and challenges in existing systems.

The aim of this study was to determine facility-based emergency care capacity in public hospitals in Zambia. This descriptive cross-sectional study comprised of a total of 23 facilities: seven districts, 12 general and four central hospitals. Data were collected using a standardised Emergency Care Assessment Tool (ECAT); developed in 2013 by AFEM to ascertain facilities' strengths and weaknesses in the delivery of the emergency care services for five sentinel conditions and maternal health. The ECAT was administered through one-on-one interviews with designated personnel working in emergency receiving areas. The assessment tool consists of six main themes relating to the ability to provide care for patients suffering from respiratory failure, shock, altered mental status, severe pain, trauma and maternal health.

The majority of facilities were able to perform almost all the procedures across all themes. However, some procedures, which were highly technical and required personnel with specialist training or specialised equipment, were not performed at all facilities. The level of the facility also dictated whether a procedure could be performed where higher-level health facilities like central hospitals were able to perform more procedures than lower-level facilities due to higher numbers of trained personnel, more equipment and supplies, and better infrastructure. Maternal health was covered in almost all (>90%) hospitals.

Across all themes, the most frequent reasons for not performing procedures were lack of supplies (n=137) followed by no training (n=136), no infrastructure (n=35) and no human resources (n=34). At the central level, the most frequent reason for not performing

procedures was no supplies (n=16), whereas at district and general levels the most frequent reason was no training. Overall, most facilities were able to offer basic emergency care services. However, there is limited capacity of training and supplies across all facilities, as well as a lack of infrastructure and policies for emergency care in lower-level facilities.

Zambian hospitals can provide basic emergency care, but there is need to enhance training and improve on provision of supplies to enable facilities to provide emergency care. Focus must also be on development of policies relating to emergency care to guide and standardise procedures. Capacity building should be more focused at district and general hospitals to improve emergency care across all levels of health facilities, as it will reduce the burden at central level and improve patient outcomes since these are first-line access points for patients.

1. INTRODUCTION

Emergency care is defined as care that is delivered in the first few hours after the onset of acute medical conditions or injury(1). It is an essential part of the health system, and serves as the first point of contact for many patients around the world, particularly those for whom access to healthcare is limited due to logistical and financial challenges(1). Emergency care is a neglected public health challenge in low- and middle-income countries (LMICs), especially in sub-Saharan Africa (2). This may in part be due to under-documentation of acute illnesses. Data that exist mostly relate to inpatient diagnoses, while other studies have shown wide under-reporting with as few as one in ten injuries being documented in official counts (3).

Both facility-based and pre-hospital emergency care are high impact and cost-effective means of secondary prevention (3). Early recognition of disease and resuscitation reduces mortality and morbidity of a wide range of diseases and injuries (1). However, there is typically no integrated approach to triage, resuscitation and rehabilitation for acutely unwell patients. In fact, at most hospitals in low-resource settings, patients will be treated by several different departments dependent on their age, sex, pregnancy status and specific disease status. This approach restricts development of a dedicated acute intake area wherein staff can be trained to be specialised in the identification of injury severity, as well as resuscitation and stabilisation(3). In addition, it limits awareness regarding emergency care and therefore restricts its development within national or regional health systems (4). One of the obstacles to emergency care development is the perception that it is an expensive system. In fact, allocating dedicated areas with non-rotating trained staff, alongside the introduction of clinical and process guidelines, is a cost-effective intervention, even when compared to primary care services (5, 6). In addition, recent years have seen massive investment in vertical disease-specific programmes which, while having great benefit for the eradication or chronic care of those conditions, has further undermined emergency care development(6). Conditions such as HIV/AIDS, TB and malaria have required concerted efforts to control, but an overlooked fact in programme development has been that patients with each of these conditions suffer emergencies at the same rates as, and perhaps even higher than, the general population. Keeping an HIV patient alive and

healthy only to have them die after a motor vehicle collision, or sepsis, or complication of their medication due to a lack of emergency care response reflects poor return on investment for health spending.

An epidemiologic transition is occurring in sub-Saharan Africa, with a shift from communicable to non-communicable diseases (NCDs) and injury(7). Low-income countries (LICs) suffer the highest rates of all kinds of injury and acute illnesses including road traffic accidents, drowning, maternal mortalities from acute pregnancy complications and acute complications of communicable diseases such as HIV, malaria and TB (7). This burden has further increased as a result of the increasing prevalence of acute complications that arise from NCDs, such as cardiovascular disease and diabetes (8). In fact, a disproportionate 80% of all NCD-related deaths occur in LICs (9). The need for emergency care is therefore increasing throughout much of sub-Saharan Africa. However the development of emergency care is not without challenges, which include difficulties with transportation, communications, equipment, facility infrastructure, medication supply chain, affordability and availability of skilled healthcare providers (9).

1.1. Health status in Zambia

Zambia is located in southern Africa, east of Angola and south of the Democratic Republic of Congo. It is a land locked country and covers a total area of 752,618 sq. km, of which 43 398 sq. km is water (10). Zambia has ten provinces and Lusaka is the capital city. It has a population of 15 million and an annual population growth rate of 2.88%. Sixty percent of the population lives below the poverty line. The country has gross domestic product (GDP) of 5.4% and depends on the mining of copper and agriculture production for income generation (10).

Zambia has a high prevalence of preventable and treatable diseases, which is reflected in the mortality and morbidity rates for the country (9). According to the World Health Organization (WHO), the life expectancy is 59 years for males and 65 years for females (11). NCDs such as stroke, coronary disease, road traffic accidents and other injuries are among

the top 20 most common causes of death in Zambia (12). Other health indicators for Zambia remain poor with high maternal and infant mortality (10).

The health care system operates under two Ministries – the Ministry of Health (MoH) and the Ministry of Community Development, Mother and Child Health (MCDMCH) - along with the Zambian Defence Force (ZDF). There are three levels of health facilities (13):

- 1st level consists of 84 health centres, health post and district hospitals,
- 2nd level consists of 19 provincial or general hospitals, and
- 3rd level consists of 7 specialist and/or central hospitals.

Zambian emergency care services are still developing but are currently provided by the Zambian MoH and the ZDF. Whilst the inclusion of Emergency Medicine as an area of medical specialisation has been proposed, Zambia does not currently have any specialist emergency physicians in practice. In 2013, the Zambian MoH decided to prioritise and enhance emergency care as a measure to reduce and prevent unnecessary deaths. In particular, nurses were trained in Critical Care nursing to improve the emergency health service system in the country (13). These efforts provide an indication that, with time, emergency care is being recognized as an important sector in improving public health in Zambia. However, there is need for further development - such as building capacity in the form of Human resource, infrastructure and supplies - to enhance and formalise emergency care in Zambia.

1.2. Motivation for study

Underdeveloped emergency care is associated with poor health outcomes (14). Early resuscitation and stabilisation substantially reduce the morbidity and mortality associated with acute medical, surgical and obstetric conditions (16, 17), and provision of a robust emergency care system can directly impact numerous targets in the Sustainable Development Goals (SDGs) (17). Despite this, emergency care is underdeveloped and under-resourced in most LMICs, including Zambia (4). A shift in the burden of disease with an

increase in NCDs and high rates of injury have recently strained systems for the provision of emergency care in Zambia and other LMICs (18).

The Zambian government decided to improve their emergency care services to help improve health outcomes. However, to properly develop emergency care, there is a need to determine practical, cost effective and sustainable strategies that will guide development while taking into account existing systems (19). In order to achieve this, there is a need to identify and describe the strengths and challenges in the existing system. These assessments will act as a starting point for Zambian authorities to improve and further develop emergency care within the country. Such an assessment may also aid in highlighting common challenges that exist across sub-Saharan Africa.

1.3. Aims and objectives

The aim of this study was to assess facility-based emergency care capacity in public hospitals in Zambia.

In order to address this aim, the specific objectives of this study were to use a standardised assessment tool to

- (i) assess the ability of facilities to deliver emergency care services for each of five sentinel conditions and maternal health, and
- (ii) describe the challenges that may result in a limited service within these facilities.

1.4. Research question

What is the current capacity to perform emergency care in public hospitals in Zambia?

2. LITERATURE REVIEW

In sub-Saharan Africa, structured emergency care systems are limited despite the fact that the region accounts for 25% of the world's disease burden(20). Every day, 16,000 people die worldwide from injuries alone, of which a disproportionate number occur in sub-Saharan Africa (21, 22). African countries suffer the highest rates of all kinds of injury, from road-traffic injuries to drowning to acute complications of pregnancy and NCDs. Poverty, political instability, war and lack of education are among the numerous local challenges that limit the number of healthcare providers, and hence provision of emergency care is often left to under-trained and/or under-prepared junior nurses or clinical officers, despite its importance (21).

The disease burden is shifting, and, as rates of NCDs and trauma-related deaths increase, there is need to provide adequate and organised treatment of time-sensitive illness and injury such as acute myocardial infarction, stroke, trauma and sepsis (9). Despite the body of evidence supporting the prevention of death and disability through emergency care, it is still neglected in low- and middle-income countries, likely due to an underfunding of trauma care combined with a lack of awareness within policy makers (22). Since the needs of emergency care services are unknown, funding allocations are often small and limit the progression and development of emergency care. Available funding is often focused on affordable rudimentary emergency services instead of quality and comprehensive care (22). A robust emergency care system has the potential to address at least three targets (child health, maternal health and infectious diseases) of the third Sustainable Development Goal, which seeks to ensure healthy lives and promote well-being for all at all ages. (18, 24). However, the lack of a systematic approach to acute care has limited the coverage of these conditions in strategic plans and international health priorities have traditionally focused on communicable diseases (24).

Evidence shows that well established systems of emergency care have the ability to reduce mortality and morbidity for common conditions in LMICs (25). In addition, there is also a demand for emergency services from the patient perspective. Although some guidelines for specific diseases and traumatic conditions include emergency clinical care guidance, these

do not cover the overall structure and management of the emergency unit, but rather cover only some aspects of emergency care. The lack of comprehensive emergency care systems in LMICs has been attributed to the emphasis and budget prioritisation being on primary health care and preventive medicine (6).

Standards relating to emergency care vary widely from well-developed high-income country systems, to basic, rudimentary systems wherein it is not uncommon to find wheelbarrows used as a means to transport patients (20). To help address these issues, the African Federation for Emergency Medicine (AFEM) was formed. AFEM has identified key challenges inherent in integrating emergency care into health systems in sub-Saharan Africa (3), including:

- In many sites, policy makers are not aware of the burden of acute diseases in their country. Acute cases are severely under documented and data that are present are fragmented and cover only selected departments within facilities or regions (3).
- Many health care facilities lack a dedicated emergency unit or an area for intake of acutely-ill patients. Facilities use a vertical approach of care whereby patients are treated based on age, sex, specific disease status and pregnancy status. As a result of this, it is difficult to find non-rotating staff that can be trained in resuscitation and stabilisation (3).
- The essential components of emergency care and acute medicine have not yet been determined and, there is, therefore, no consensus on how to define or measure the success of interventions. There are examples of successful interventions but no systematic approach to analyse emergency care delivery systems has been adopted (3).
- There is no advocacy plan to place emergency or acute care on the global agenda. Despite the importance of emergency care, it is not explicitly recognised in global health goals (3, 18).

In order to address these challenges, there is a need to comprehensively assess and identify the unmet needs of emergency care, as recommended by the WHO (26). These needs assessments are key components in the development of emergency care and are a first step

in health services development, as they aid in establishing existing capacity as well as identifying priorities for development.

2.1. Emergency care assessment

Emergency care is developing and growing in many health care facilities in African countries, but there is no standardised and accurate assessment tool to guide these implementations. The WHO has five tools relating to emergency care:

- Guidelines for Essential Trauma Care: a list of 260 items covering both human and physical resources that would be required by a facility to provide appropriate care to an injured person. It is categorised into three documents by level of health facility. This tool highlights what each facility should have, but does not aid in designating the health facility based on the results of the checklist (31, 33).
- Integrated Management for Emergency and Essential Surgical Care toolkit: this provides an equipment list and needs assessment, but is focused mainly on first-referral health facilities (32, 34, 35).
- Pre-Hospital Trauma Care Systems: this form helps to identify the skills, supplies, and equipment that will enable community members and healthcare providers to assess, stabilise and transport injured victims to appropriate facilities. The tool largely focuses on the pre-hospital phase of emergency care (30).
- Pre-hospital Trauma Systems Checklist: this checklist is used for assessing knowledge, skills, equipment and supplies in trauma and injury care (30). However, it does not cover clinical skills, equipment, supplies or medicines commonly used to treat medical or obstetric emergencies (30).
- Monitoring Emergency Obstetric Care Handbook: this is a guide used for defining health facilities with regard to their capacity to treat obstetric and newborn emergencies. These definitions are then used to guide users on the availability of the services at that facility (31).

As observed, each of the tools mentioned above are not comprehensive enough to assess emergency service provision, because they either focus on one category of emergency care and or one facility level. Hence, there is a need for a standardised assessment tool that will help in the evolution of the emergency care system as well as guide health care facilities in the implementation of affordable and effective emergency care (31).

Previous studies assessing capacity to deliver emergency care have been effective in identifying strengths and deficiencies that exist in healthcare facilities in Africa. A study conducted by Levine *et al* (32) in the central province of Zambia assessed availability and accessibility of emergency obstetric care, and showed both the capacities of the health facilities and gaps that existed. For example, the majority of the health centres had the medications (penicillin, oxytocin, ampicillin) necessary for obstetric care and the staff reported being entirely comfortable performing basic procedures such as basic vaginal deliveries, administration of IV medications and treating infections, but few facilities had the necessary equipment to perform removal of retained products of conception or assisted vaginal delivery. As defined by the 1997 United Nations (UN) Guideline for obstetric care, none of the health centres in Zambia had the capacity to perform basic emergency obstetric care (28,29). The assessment provided insight into the provision of emergency obstetric care in Zambia, but it also managed to assess health care providers' self-reported capacities to perform certain skills.

A similar study in Sierra Leone conducted a structured needs assessment to establish the existing capacity to deliver emergency care in Freetown (33). Authors used a set of structured standards that defined the minimum requirements for effective emergency and critical care delivery; it is important to note that these standards were both relevant and realistic in the LIC context. This study covered a wider spectrum of departments (paediatrics, trauma, surgery and anaesthesia) and all aspects of capacity (infrastructure, human resource, training, drug, systems, diagnostics and guidelines). The study also looked at different types of health facilities: tertiary hospitals, private hospitals, facilities that already had dedicated emergency services and specialised care hospitals. The authors reported that capacity was strongest in drug availability and human resource and lowest in terms of infrastructure. There was great variation in capacity, such as training, diagnostics

and equipment, found between the different levels of government hospitals and between government and private facilities, with private hospitals having stronger capacities. This study showed that capacity assessment can be conducted in a hospital-wide manner, i.e. including all sections of the hospitals, and also across different levels of the healthcare system.

Capacity assessments provide in-depth information about the emergency care service delivery in a country as well as aid in highlighting variations between facilities. Identifying these variations can promote standardisation of equipment, systems and guidelines, allow evidenced-based determination of essential components of emergency care and provide a basis for learning. These findings form the basis for improvement plans and are found to have positive impacts on development and improving services in emergency care. As in other LICs, Ghana's formal pre-hospital transport system is limited. Injured patients are typically transported using commercial vehicles, taxis or buses and drivers have no knowledge of emergency care or first aid. A study assessing the efficacy of a first aid training program offered to commercial drivers compared the process of pre-hospital trauma care provided before and after the training(27). An improvement was seen post training where 61% of drivers were able to provide first aid after taking the course. Similarly, improvements were reported in provision of the component of first aid management; crash scene management improved from 7% to 35% and airway management improved from 2% to 35% following training(27). This study shows that assessments are necessary for improvement as they not only identify the deficiencies within a system but can also document and assess the efficacy of an intervention. The evidence presented shows that, once the capacity is known and documented through assessments, there is a possibility to improve emergency care by building on the existing, even informal systems and patterns already in place. This could be cost-effective, quicker and more adaptable than establishing or introducing new programmes and systems.

An assessment of the provision of emergency obstetric care in specialist hospitals in Nigeria found poor capacity in emergency obstetric care in addition to excessive delays (33). This was addressed by several specialist obstetricians visiting the hospital providing care to patients as well as training the general physicians and midwives. A first aid box with

essential drugs and supplies was introduced for emergency cases, and midwives were trained to identify and manage obstetric complications. After these interventions, the case fatality rate among women with complications dropped from 22% to 5% and the number of women with complications actively seeking out treatment increased. This is in contrast to what happened before training, when pregnant women did not seek care due to poor services(33). This study shows that the assessment aided in identifying and addressing the challenge;providing an insight into the importance and positive impact of capacity assessment in improving and developing emergency care.

Capacity assessments highlight deficiencies and define the current status of emergency care delivery at a facility. Additionally, they can provide information across a nation or regionally on some of the common challenges that individual countries face; for example, if all African countries have a challenge in training of specialised emergency care healthcare workers because of unavailability of emergency care curriculum, then this could be addressed at a regional level and implemented in the individual countries. This promotes standardisation within a region and in turn strengthens and increases emphasis on the importance of emergency care as part of the public health system. It also adds to the existing knowledge of emergency care and simple cost-effective strategies that may be observed during capacity assessment may be adopted in similar health facilities nationally as well as regionally.

2.2. The AFEM assessment tool

The Emergency Care Assessment Tool (ECAT) is an AFEM tool which was developed in 2013 based on the agreement on the signal functions needed to successfully care for pre-identified sentinel conditions from the second AFEM Consensus Conference. The main aim of the ECAT is to ascertain facilities' strengths and weaknesses in the delivery of the emergency care services for five sentinel conditions and maternal health. The conditions were agreed upon at the conference as core areas which each health facility, regardless of resource level, should be equipped to recognise and manage in a timely fashion using the appropriate resources. These sentinel conditions were selected and adapted from the three

delay model that was developed for reducing maternal mortality. It was agreed that these concepts could be applied to emergency health services in low and middle income countries and have similar positive impacts as seen in maternal mortality reduction(34).

With guidance from the WHO *Integrated Management of Adult and Adolescent Illness* framework (35) , five sentinel conditions were agreed and accepted for inclusion on the ECAT, namely:

- Respiratory failure,
- Shock states,
- Altered mental status,
- Dangerous fever, and
- Severe pain or trauma (35).

The ECAT tool was used and found to be most suitable to be used for this study as it assesses a facility's ability to perform signal functions in relation to the five sentinel conditions, instead of categorising facilities as “basic”, “intermediate”, or “advanced” like existing WHO tools do. Since this tool is focused on individual procedures, the findings may allow for focusing of limited resources where it is needed most, making it a suitable tool for use in low and middle income countries where resources are limited. It also assesses if available facilities can manage basic emergencies and aids in assessing the quality of care provided. It also provides data that can guide health care facilities in the implementation of affordable and effective emergency care.

The ECAT was piloted at two sites and lessons learned were incorporated into a revised version of the tool through a consensus process. The final ECAT – as used in this study – looks at whether signal functions can be managed successfully 90% of the time they are required in the emergency unit and, if not, what the reasons for failure were. The final ECAT tool is a questionnaire which is divided into six main themes, in line with the modified sentinel conditions:

1. Respiratory failure,
2. Shock,
3. Altered mental status,

4. Severe pain,
5. Trauma, and
6. Maternal health.

3. METHODS

3.1. Study Design

This was a descriptive cross-sectional study. We included a selection of health facilities at different levels of the healthcare system. Data from each facility were collected over the same period of time using the ECAT. Data were collected on number of facilities that were able to perform a particular procedure in emergency units.

The study was conducted to assess the status of current emergency care capacity of the health facilities in Zambia. This study was done with limited funding from AFEM (to cover travel and accommodation) and support from the Zambian MoH.

3.2. Study Setting

Zambia was chosen for this study because it has recently established a MoH lead for emergency care and is trying to improve its care provision. It has an established relationship with the University of Cape Town and AFEM, and has previously identified the need for an in-country assessment of the provision of emergency care services. At the MoH's request, AFEM has been assisting Zambia with the development of emergency care within the country. Zambia is reasonably representative of most LICs in the region and its challenges in emergency care provision are likely to be applicable to other countries in the region.

This study included hospitals across all levels of the health system: district (level one), provincial or general (level two) and central (level three). District hospitals serve a population of between 80,000 and 20,000 and offer medical, surgical, obstetric and diagnostic services (36). General or provincial hospitals provide services for a catchment area of between 200,000 and 800,000 people, and provide internal medicine, general surgery, paediatric, obstetrics and gynaecology, dental, psychiatry and intensive care services (36). These also act as referrals for the level one facility. Central hospitals are the highest referral hospitals in Zambia and cater for catchments of approximately 800,000

people and above. They offer sub-specialisation in internal medicine, surgery, paediatrics, obstetrics, gynaecology, intensive care, psychiatry, training and research. Complicated cases from general hospitals are referred to these facilities (36).

The health facilities were selected from all facilities within the ten provinces. However, during data collection three provinces (Western, North Western, Luapula) were inaccessible due to weather conditions and could not be included. Therefore, these were replaced with other facilities from the seven provinces visited (Table 1). Originally, a total of 26 hospitals were to be assessed; one district and one general hospital from each province, and all central hospitals. In total, 23 were recruited and visited. The district and provincial facilities were selected using non-probability convenience sampling in collaboration with Zambian MoH. There are six central hospitals of which only four were included (one is privately owned and operates independent of the system, and one did not grant permission). At each facility, either a doctor, clinical officer or nurse were interviewed. Table 1 shows the breakdown of the facilities assessed.

Table 1: Facilities surveyed using the Emergency Care Assessment Tool

Province	Central Hospitals	Provincial/General Hospitals	District Hospitals
Lusaka Province	2	1	2
Copperbelt Province	2	4	1
Central Province	-	2	2
Eastern Province	-	1	-
Southern Province	-	4	-
Northern Province	-	1	-
Muchinga Province	-	-	1
Luapula Province	-	-	-
North-western Province	-	-	-
Western Province	-	-	-

3.3. Recruitment and Enrolment

In consultation with the MoH, and considering regional representation and geographic placement, weather conditions and accessibility, regional and district hospitals were

selected from 113 facilities and from seven provinces using convenience sampling. Out of 113, a total of 23 health facilities were sampled: 7 district, 12 general and 4 central. The facilities were informed by the Zambian MoH that they had been selected as study sites and were to be included in the study. The investigator was formally introduced to each facility through a letter. Private hospitals were not included as the scope of this study was government owned hospitals only.

Consent was sought from individual facilities from the member of staff (doctors, clinical officer and nurse) designated by the hospital authorities to participate in the assessment: a consent form was signed (Appendix 2).

3.4. Inclusion criteria

All public hospitals were eligible for inclusion. The clinician designated as responsible for emergency care at the facility was the intended staff member for the assessment.

3.5. Exclusion criteria

Private facilities and facilities that did not have a full-time doctor, clinical officer or nurse working in the emergency receiving area were excluded, as were those who refused consent.

3.6. Data Collection and Management

Data were collected using the ECAT (Appendix 1) through a one-on-one interview. The same data collection process was followed in each case (Appendix 3). The facilities were contacted prior to the visit. Upon arrival, consent was sought and forms signed. The designated person to complete the assessment was the hospital's lead for the emergency care area. Written and verbal instructions for completing the ECAT form were provided to

the staff member. Thereafter, the assessment was completed by the clinician: the lead investigator (CC) was available to answer any questions of clarity. One ECAT form was collected per health facility.

This study utilised the ECAT because it assesses a facility's ability to perform signal functions in relation to the five sentinel conditions, instead of categorising facilities as "basic", "intermediate", or "advanced" like existing WHO tools do (38). The tool first captures the name and location of the facility (Appendix 1). There are questions pertaining to procedures performed under the named theme where each question can be answered with a "yes" or "no". For any question that is answered with a "no", a reason for not performing the procedure must be given. Reasons for not performing procedures are chosen from a predefined list as follows:

- Policies,
- Human resource,
- Healthcare worker training,
- Supplies,
- Equipment,
- Medication,
- Infrastructure,
- No indication, and
- Other/comments.

When the reason for not performing the procedure was not listed, a space was provided for documenting the new reason.

Data were entered onto a Microsoft Excel (© Microsoft, Richmond, WA) spreadsheet on a password-protected computer.

3.7. Statistical Analysis

Basic descriptive statistics were reported in the form of frequency tables, histograms, means and standard deviations. Where necessary, medians were also reported.

3.8. Ethical Consideration

Approval was gained from the University of Cape Town Health Research Ethics Committee (HRECREF: 841/2015) (Appendix 4) and University of Zambia biomedical research ethics committee (UNZABREC)/ Zambia MoH (Ref: 008-01-16) (Appendix 5).

4. RESULTS

A total of 26 health facilities (eight district, 12 general and six central hospitals) were approached for assessment; 23 (88%) agreed to be assessed. Four of the 23 (15%) were central, 12 (50%) general and seven (23%) district hospitals. The following sections discuss each of the signal functions in depth.

Overall, across all themes central hospitals were able to perform more procedures (96%) in comparison to general (72%) and district (71%) hospitals (figure 1). For central hospitals supplies was a common reason for not being able to perform procedures whereas for district and general hospitals, training was the most common reason for not being able to perform procedures. Across all themes except for maternal health, the most frequent reason for not performing procedures were no training (n=261), followed by no supplies (n=162), no human resource (n=82), no infrastructure (n=17), and no policy (n=6) (Table 2). For maternal health, all facilities were able to perform all procedures that were available at their facilities (Table 2).

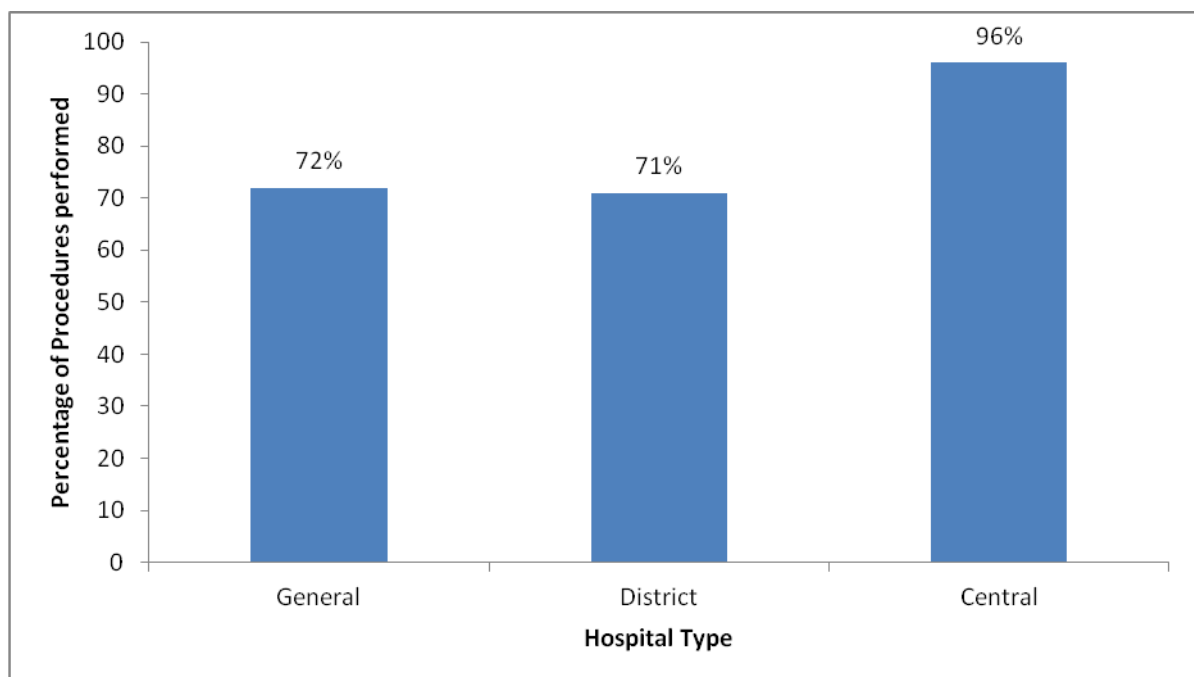


Figure 1: Percentage of procedures performed across all themes by hospital type

Table 2: Frequency (counts) of reasons for not performing procedures associated with emergency medicine

	Respiratory failure	Shock	Altered mental status	Severe Pain	Trauma	Maternal Health	Totals
No training	35	48	83	7	88	-	261
No supplies	18	17	35	7	85	-	162
No Human Resource	2	26	28	0	26	-	82
No infrastructure	2	4	6	2	3	-	17
No policy	0	4	0	0	2	-	6
No indication	3	2	5	0	1	-	11

The most frequent reason for not performing procedures at general hospital level was no training (n=198), followed by no supplies (n=192), no human resource (n=42), no infrastructure (n=30), and no policy (n=10). The most frequent reason for not performing procedures at district hospital level was no training (n=148), no human resource (n=94), no policy (n=22) and no infrastructure (n=4). The most frequent reason for not performing procedures at central hospital level was no supplies (n=16), followed by no training (n=12), no human resource (n=4) and no infrastructure (n=2) (Table 3).

Table 3: Frequency (counts) of reasons for not performing procedures by facility type

	General Hospital	District Hospital	Central Hospital
No training	198	148	12
No supplies	192	46	16
No Human Resource	42	94	4
No infrastructure	30	4	2
No policy	10	22	0
No indication	14	0	0

4.1. Respiratory Failure

All of facilities reported being able to perform all procedures related to obstructed airway except for surgical airway/cricothyrotomy; of which less than half (48%) of the facilities reported being able to perform (Figure 2). More than 57% of facilities were able to perform all respiratory distress-related procedures except for invasive and non-invasive mechanical ventilation (Figure 3). Lack of training (n=27) was the most frequent reason for not being able to perform procedures related to respiratory failure, followed by no supplies (n=18), no indication as to why the procedure could not be performed (n=3), no infrastructure (n=3) and no human resource (n=2) (Table 4).

For respiratory failure-related procedures, most (58%) of the general hospitals were not able to perform supraglottic device placement. At the district level, most (71%) of the facilities were not able to perform surgical airway/cricothyrotomy (Figure 4). In addition to the other procedures, supraglottic device placement was available at the central level, indicating that higher-level facilities were able to offer the more complex procedures.

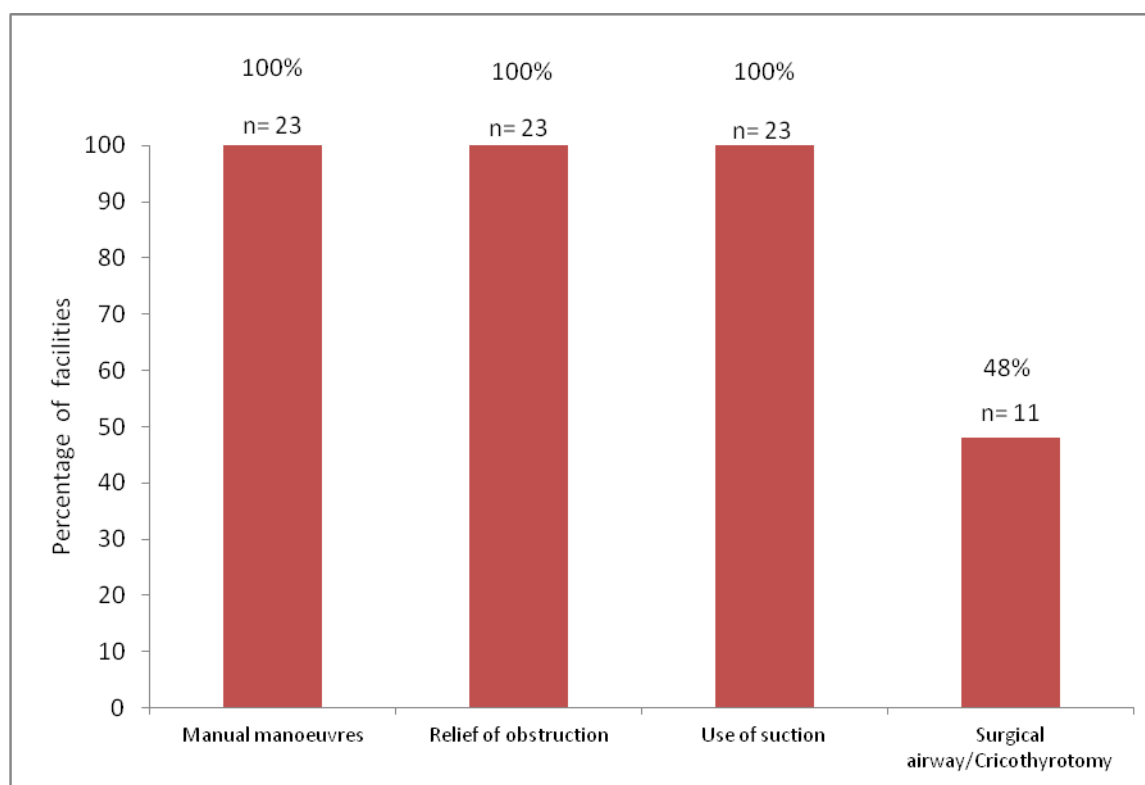


Figure 2: Percentage of health facilities able to perform procedures associated with obstructed airway

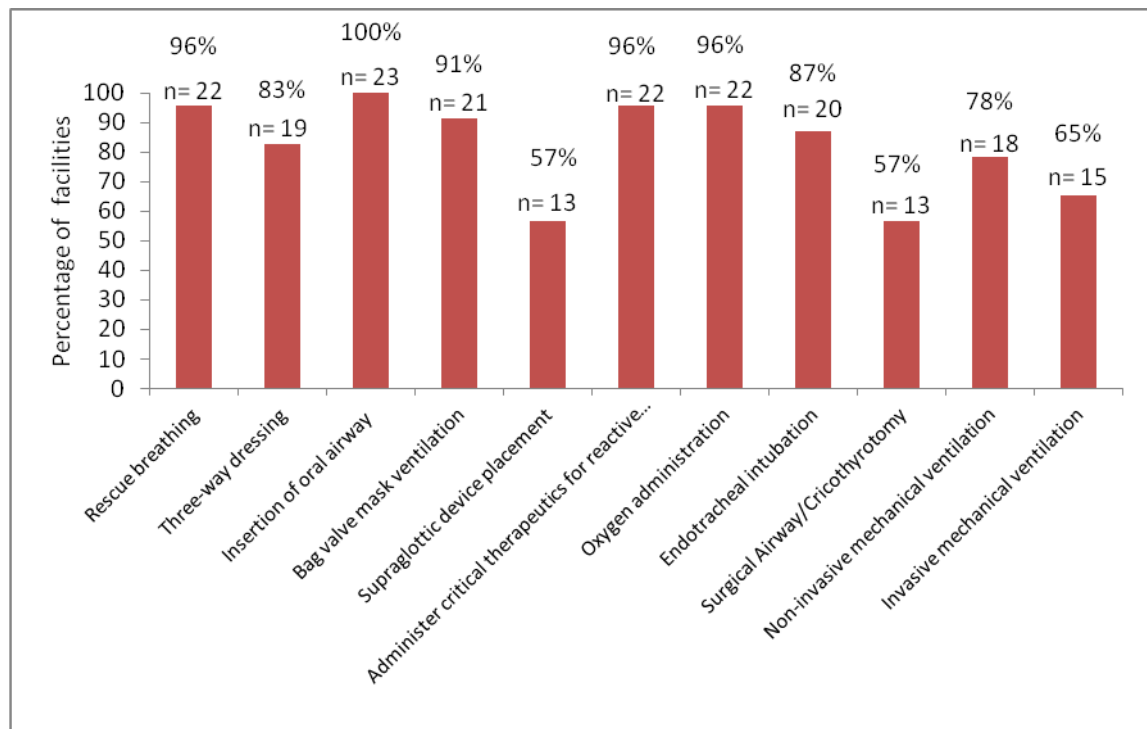


Figure 3: Percentage of health facilities able to perform procedures associated with respiratory distress

Table 4: Frequency (counts) of reasons for not performing procedures related to respiratory failure

	Surgical airway/cricothyrotomy	Three-way dressing	Bag valve mask ventilation	Supraglottic device placement	Endotracheal intubation	Non-invasive mechanical ventilation	Invasive mechanical ventilation	Totals
No training	8	1	-	8	2	2	6	27
No supplies	4	3	1	4	-	2	4	18
No Human Resource	1	-	-	-	1	-	-	2
No infrastructure	2	-	-	-	-	1	-	3
No policy	-	-	-	-	-	-	-	0
No indication	2	-	-	1	-	-	-	3

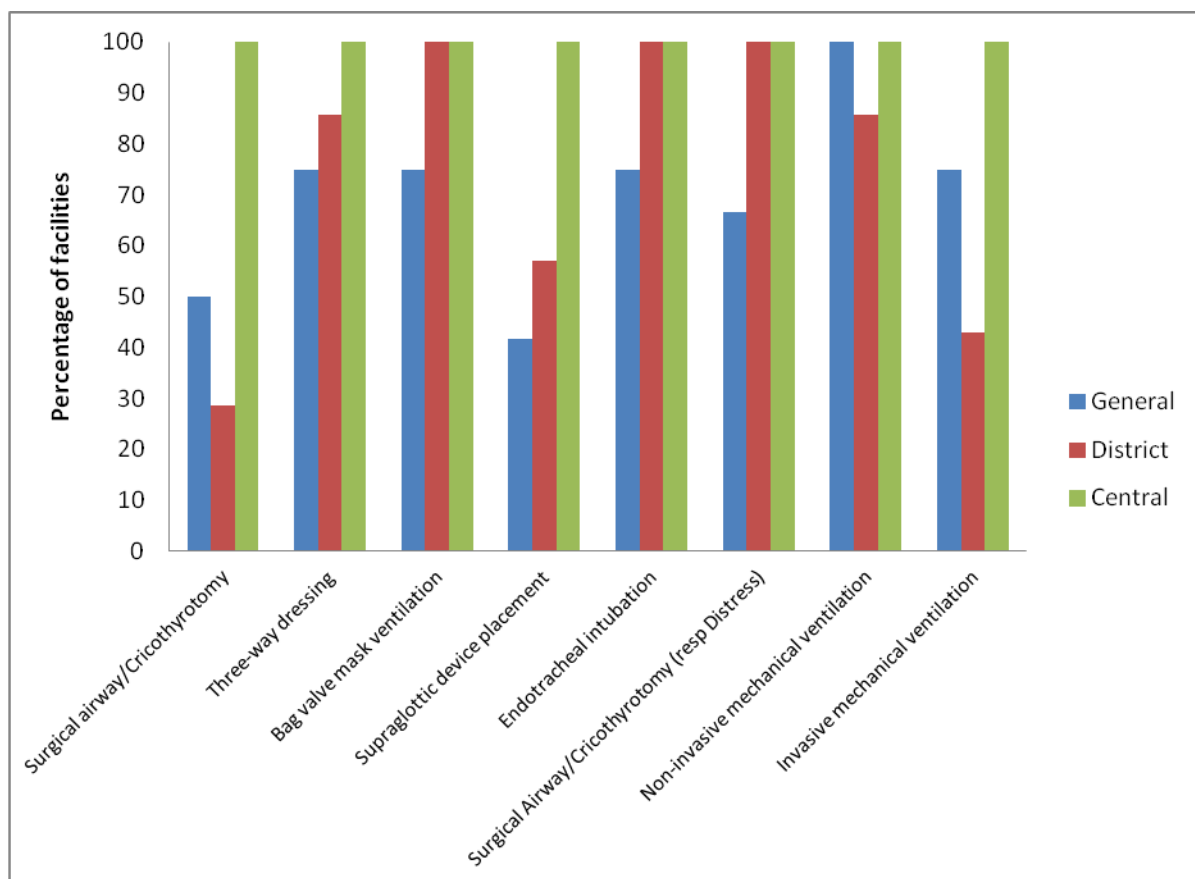


Figure 4: Percentage of facilities performing procedures related to respiratory failure by health facility type

4.2. Shock

4.2.1. Haemorrhagic shock

All (100%) facilities stated that they could provide pathogen-screened transfusions, physical manoeuvres, packing and suturing for control of haemorrhages. Procedures related to the insertion of medical devices for intravenous access and central venous were reported to be available in 91% and 74% of facilities respectively, except for intraosseous access, which was only reported to be performed at 57% of the facilities. Pelvic wrapping was a procedure that was stated to be performed by less than half (48%) of facilities (Figure 5).

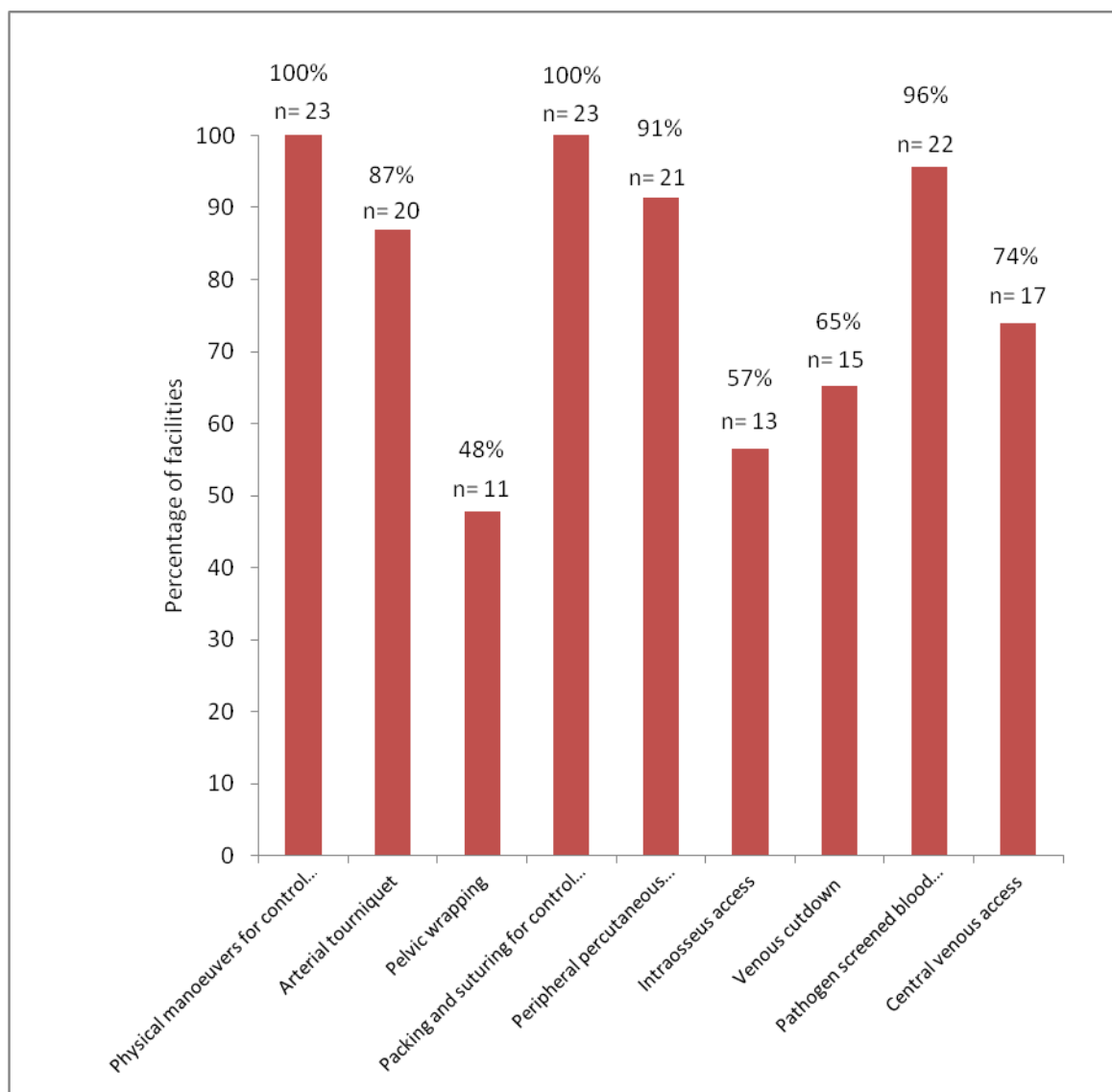


Figure 5: Percentage of health facilities that are able to perform procedures related to haemorrhagic shock

4.2.2. Other forms of shock

Almost all facilities stated that they were able to perform needle decompression of tension pneumothorax (91%) and administration of intravenous medications that require advanced monitoring by intramuscular and intravenous methods (91%). Fifty two percent (52%) of the health facilities were able to interpret electrocardiogram (ECG); less than half were able to perform external defibrillation/cardioversion (Figure 6). Pericardiocentesis was performed at 65% of facilities.

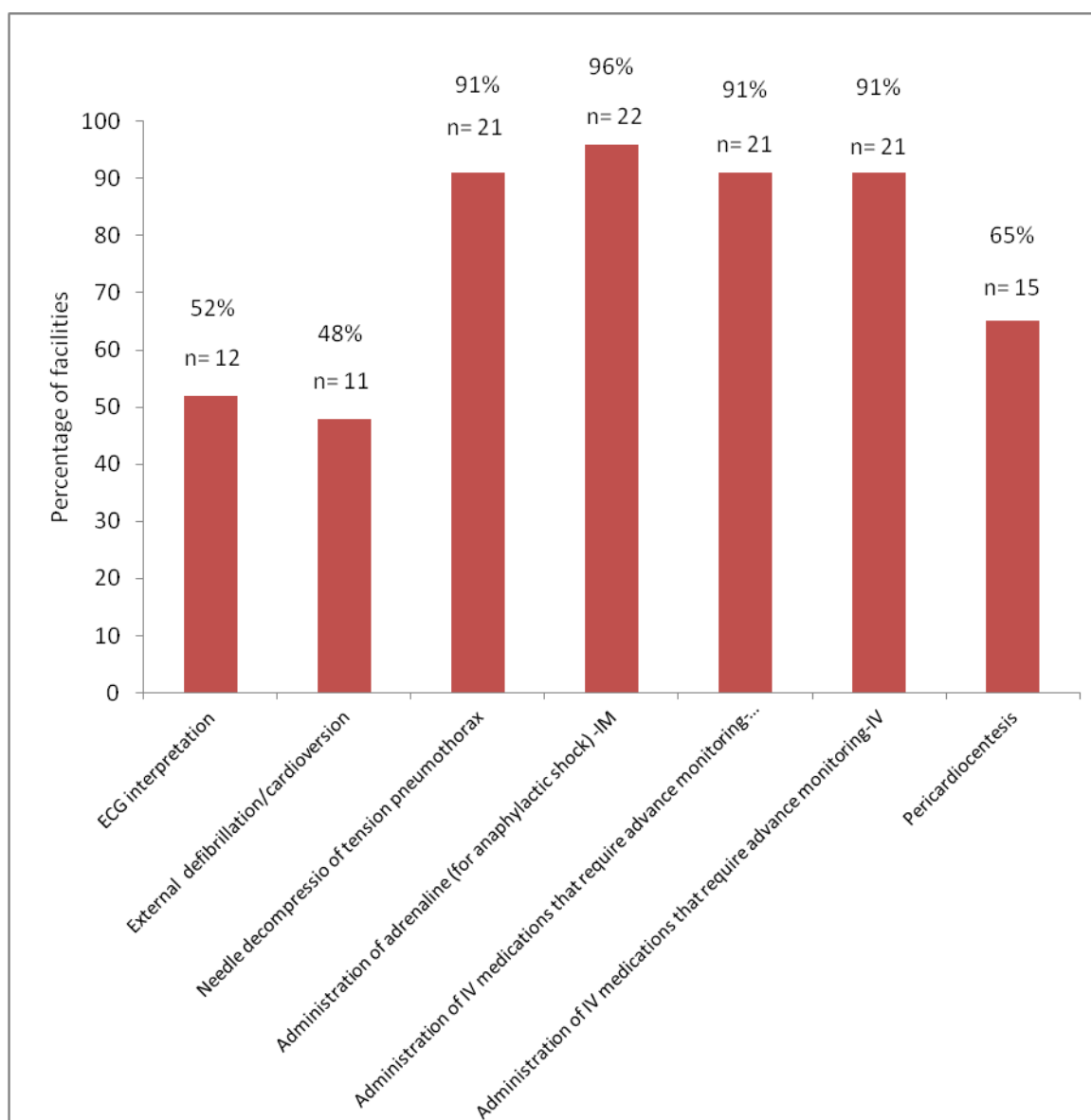


Figure 6: Percentage of health facilities that are able to perform procedures related to other shock

The most frequent reason for not performing shock-related procedures was lack of training (n=48), followed by lack of human resource (n=26), no supplies (n=17), no policies (n=4), and no infrastructure (n=4) (Table 5). Lack of training was a common reason for not performing procedures that were more complex and required more workplace training, such as pelvic wrapping (n=7), venous cut down (n=7), intraosseus access (n=8) and electrocardiogram (ECG) (n=10). For these more advanced procedures; pelvic wrapping (n=5) and intraosseus

(n=4) lack of supplies was also a common reason for not performing them at their facilities, suggesting that this could be a factor for not being able to train the staff at the facility.

For shock-related procedures, 75% facilities were not able to perform pelvic wrapping at general hospitals and 86% of facilities were not able to perform external defibrillation at district level (Figure 7). All central hospitals were able to perform all procedures.

Table 5: Frequency (counts) of Reasons for not Performing Procedures Related to Shock

	Arterial tourniquet	Pelvic wrapping	Peripheral percutaneous intravenous access	Intraosseous access	Venous cutdown	Central venous access	ECG interpretation	External defibrillation/cardioversion	Needle decompression of tension pneumothorax	Administration of adrenaline (for anaphylactic shock) -IM ¹	Administration of adrenaline (for anaphylactic shock) -IV ² (%)	Administration of IV medications that require advance monitoring-IM	Administration of IV medications that require advance monitoring-IV	Pericardiocentesis	Totals
No training		7	1	8	7	4	10	9	-	-	-	-	-	2	48
No supplies	1	5	1	4	2	2	-	1	-	-	-	-	1	-	17
No Human Resource	1	-	-	-	-	-	9	5	2	-	-	2	1	6	26
No infra-structure	-	1	-	-	-	-	-	-	-	1	1	-	-	1	4
No policy	-	-	-	-	1	1	-	-	-	-	-	-	-	2	4
No indication	-	-	-	1	-	1	-	-	-	-	-	-	-	-	2

¹ Intramuscular

² Intravenous

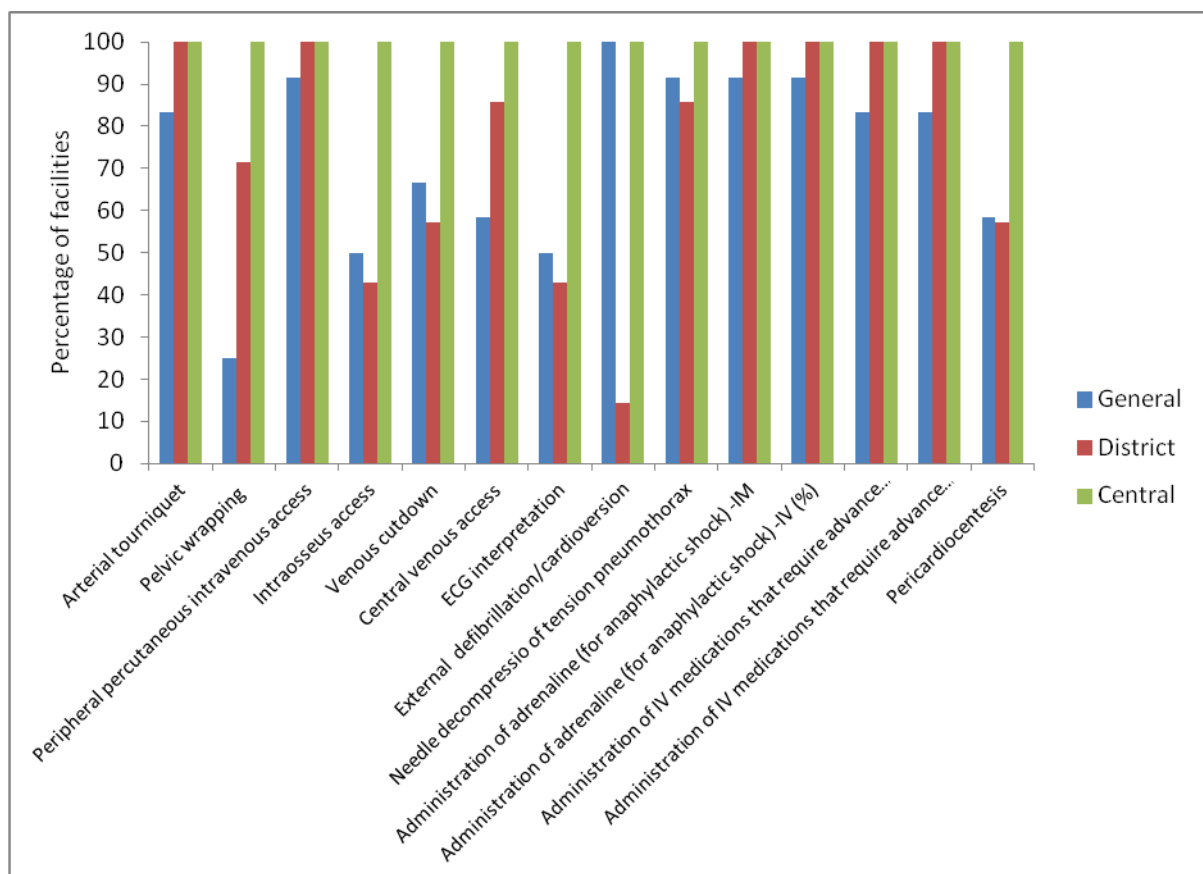


Figure 7: Percentage of facilities performing procedures related to shock by health facility

4.3. Altered Mental Status

4.3.1. Unconscious patients

All facilities were able to manage procedures associated with the unconscious patient, except for performing a head computed tomography (CT) scan, which only 26% were capable of doing. Of that 26%, one (4%) was a district hospital, two (9%) were general and three (13%) were central hospitals (Figure 8); most district and general facilities were not able to perform head CT whereas at central level, only one facility was not able to perform head CT (Figure 9).

Head CT scan was not performed at most facilities mainly due to lack of supplies, training and infrastructure. At all levels, lack of both supplies and training were reasons for not performing head CT scans. District (n=6) and general (n=4) hospitals had no human resource

to be able to perform head CT scan, and some general (n=7) and central (n=1) hospitals had no infrastructure to enable them to offer head CT scan (Table 6).

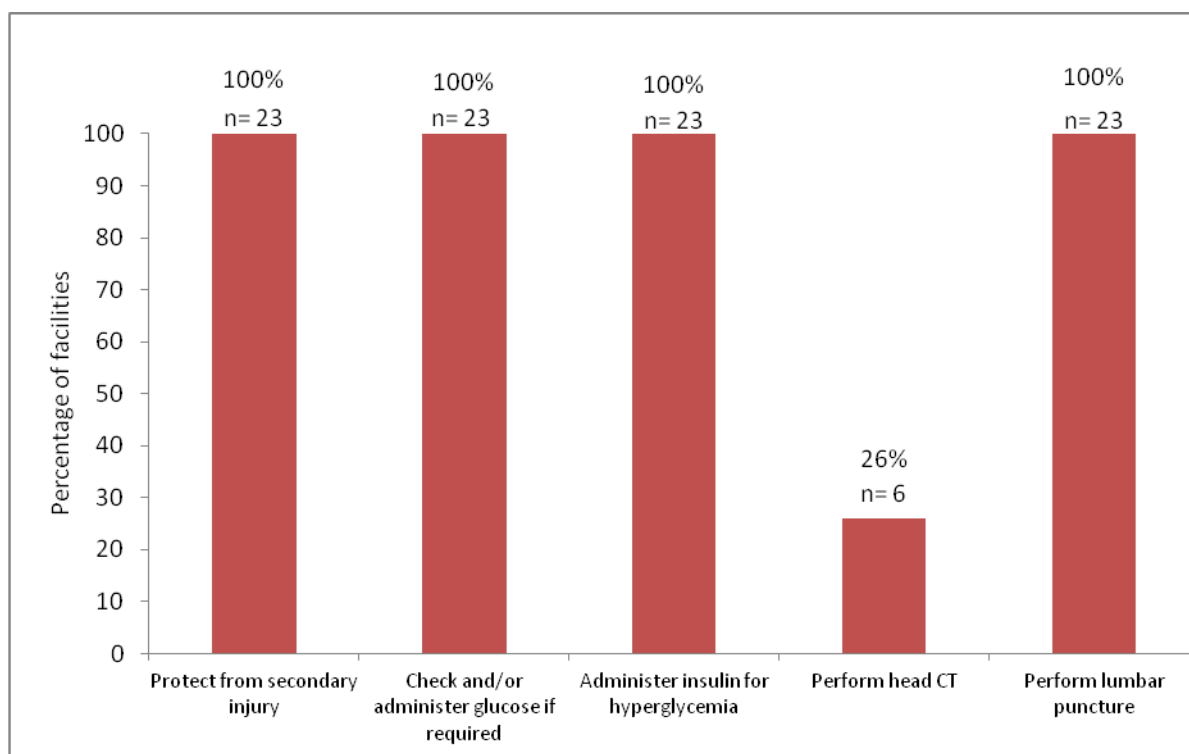


Figure 8: Percentage of health facilities that are able to perform procedures related to unconscious patients

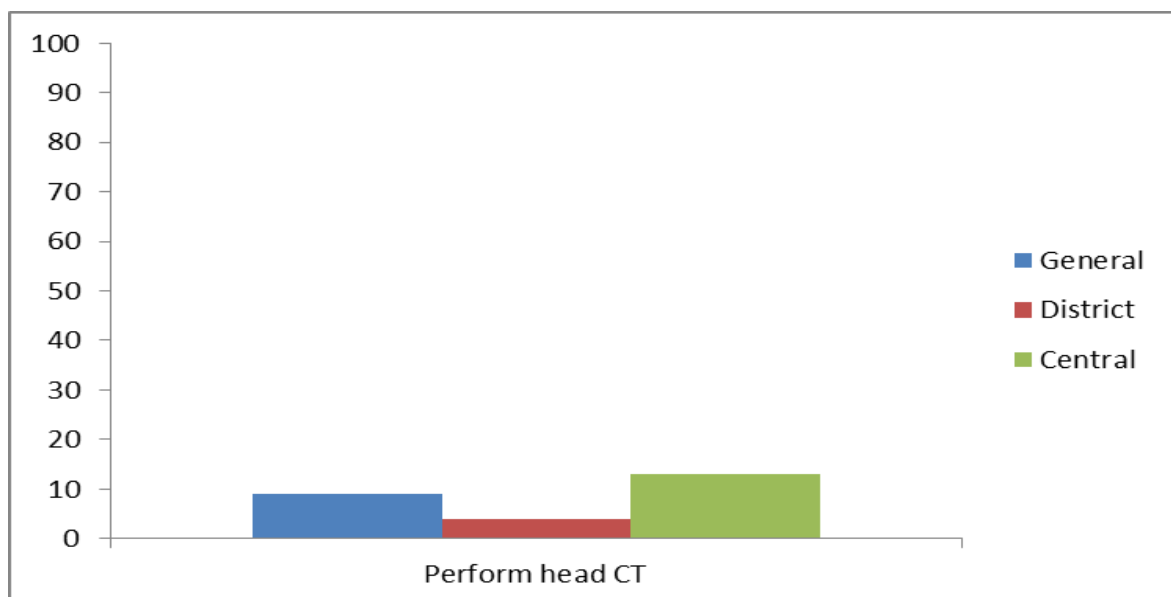


Figure 9: Percentage of facilities performing Head Computed Tomography (CT) by health facility type

Table 6: Frequency (counts) of reasons for not performing head CT scan

	General Hospital	District Hospital	Central Hospital
No training	8	6	1
No supplies	10	6	1
No Human Resource	4	6	-
No infrastructure	7	-	1
No policy	-	-	-
No indication	-	-	-

4.3.2. Seizures

All (100%) of facilities were able to administer benzodiazepines (Figure 10) and manage extremes of temperature (Figure 11). More than 90% reported being able to administer parenteral magnesium sulphate for pregnant patients and locally-appropriate antidotes for toxic causes, and to be able to perform mental status examinations.

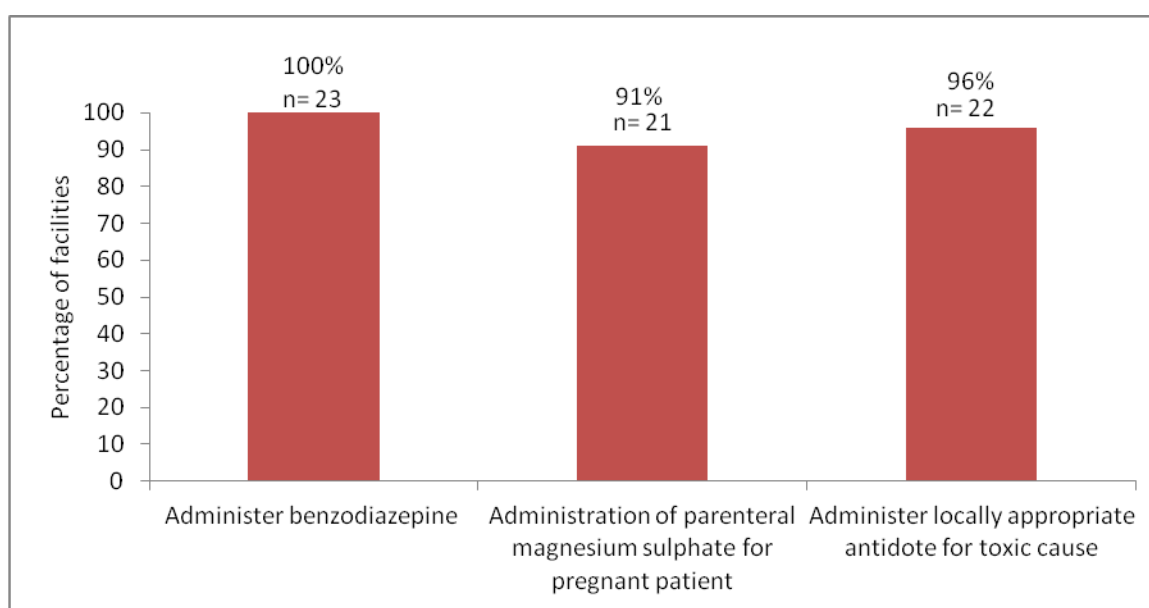


Figure 10: Percentage of health facilities that are able to perform procedures related to seizures

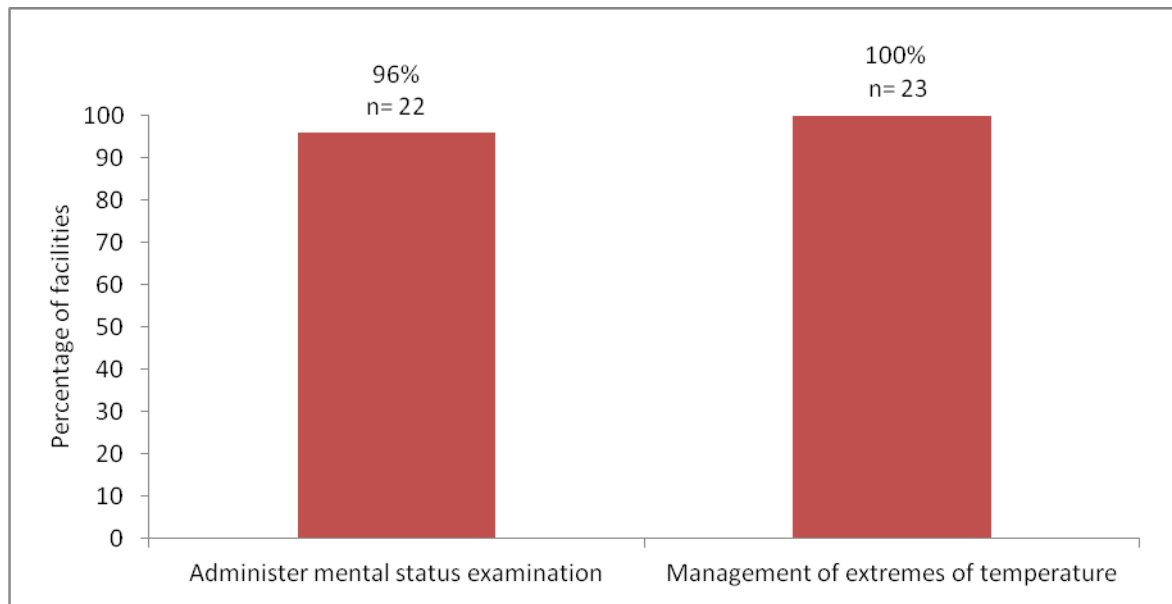


Figure 11: Percentage of health facilities that are able to perform procedures related to other types of altered mental status

The most frequent reasons for not performing procedures related to altered mental status were lack of supplies (n=18), followed by no training (n=16), no infrastructure (n=14), and no human resource (n=4) (Table 7). For procedures such as CT scans, which require dedicated space for equipment and specialised staff, the most common reasons were no infrastructure, lack of human resource to carry out the procedure and absence of CT scan machines.

Table 7: Frequency (counts) of reasons for not performing procedures related to altered mental status

	Perform head CT³	Administer locally appropriate antidote for toxic cause	Administer mental status examination	Totals
No training	15	-	1	16
No supplies	17	1	-	18
No Human Resource	4	-	-	4
No infrastructure	14	-	-	14
No policy	-	-	-	0
No indication	-	-	-	0

4.4. Severe Pain

All (100%) facilities were able to administer opiate-based analgesia and perform urine dipstick and human chorionic gonadotropin (HCG) measurement. All could perform oral hydration, placement of Foley catheter for urinary outlet obstruction, and undertake a chest x-ray. Seventy eight percent (78%) of facilities were able to provide therapeutic paracentesis. Ultrasound was available in 87% of health facilities, and 83% of health facilities were able to administer aspirin (Figure 12).

³ Computed tomography

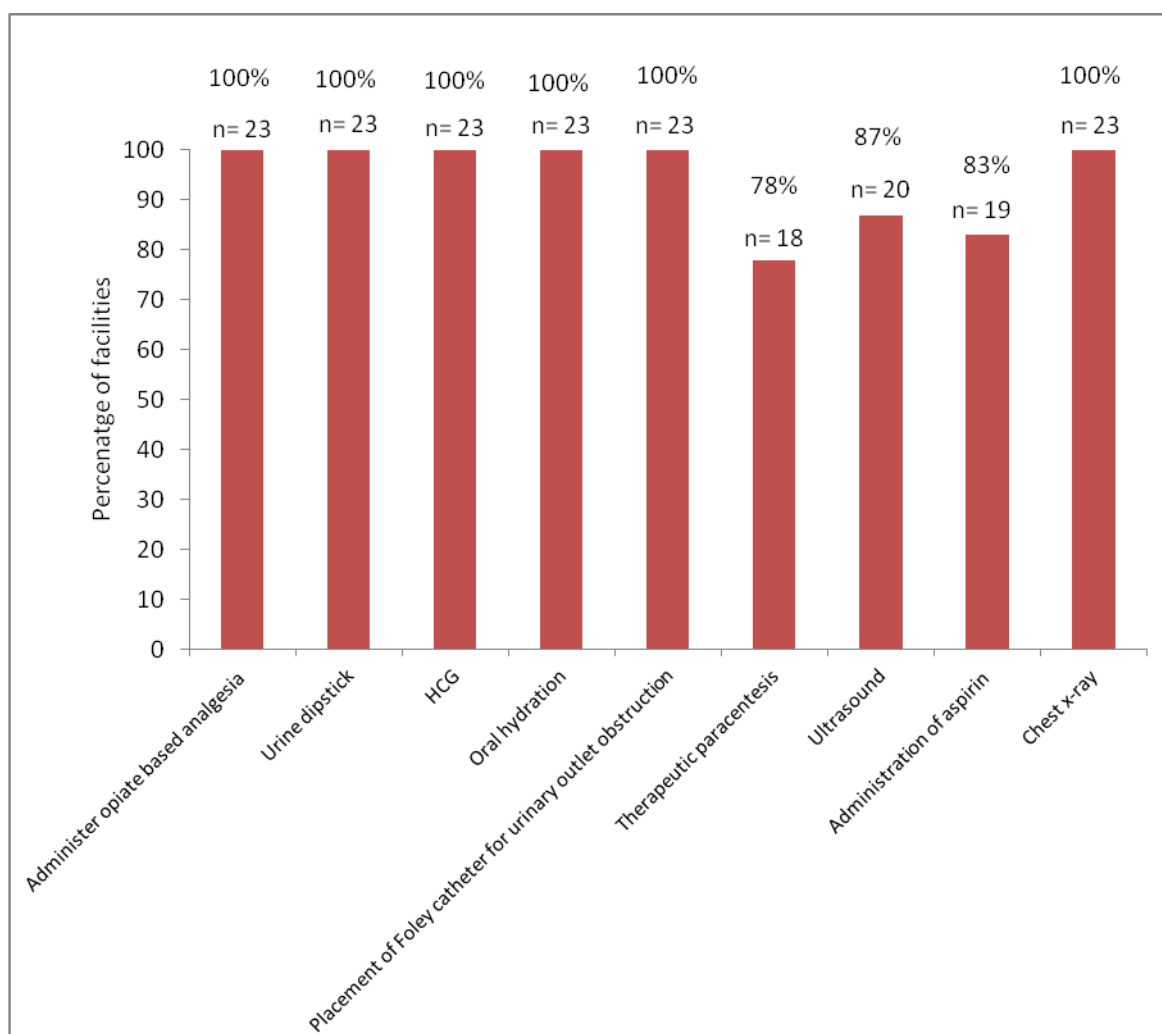


Figure 12: Percentage of health facilities that are able to perform procedures related to severe pain

The most frequent reason for not performing procedures related to severe pain were no supplies (n=7) no training (n=7) and no infrastructure (n=2) (Table 8). For severe pain related procedures, mental status examination was performed in all facilities regardless of hospital level. Aspirin administration was being performed in all of the district hospitals, however aspirin administration was only available in 75% of general and central hospitals(Figure 13).

Table 8: Frequency (counts) of reasons for not performing procedures related to severe pain

	Therapeutic paracentesis	Ultrasound	Administration of aspirin	Totals
No training	4	1	2	7
No supplies	1	2	4	7
No Human Resource	-	-	-	0
No infrastructure	1	1	-	2
No policy	-	-	-	0
No indication	-	-	-	0

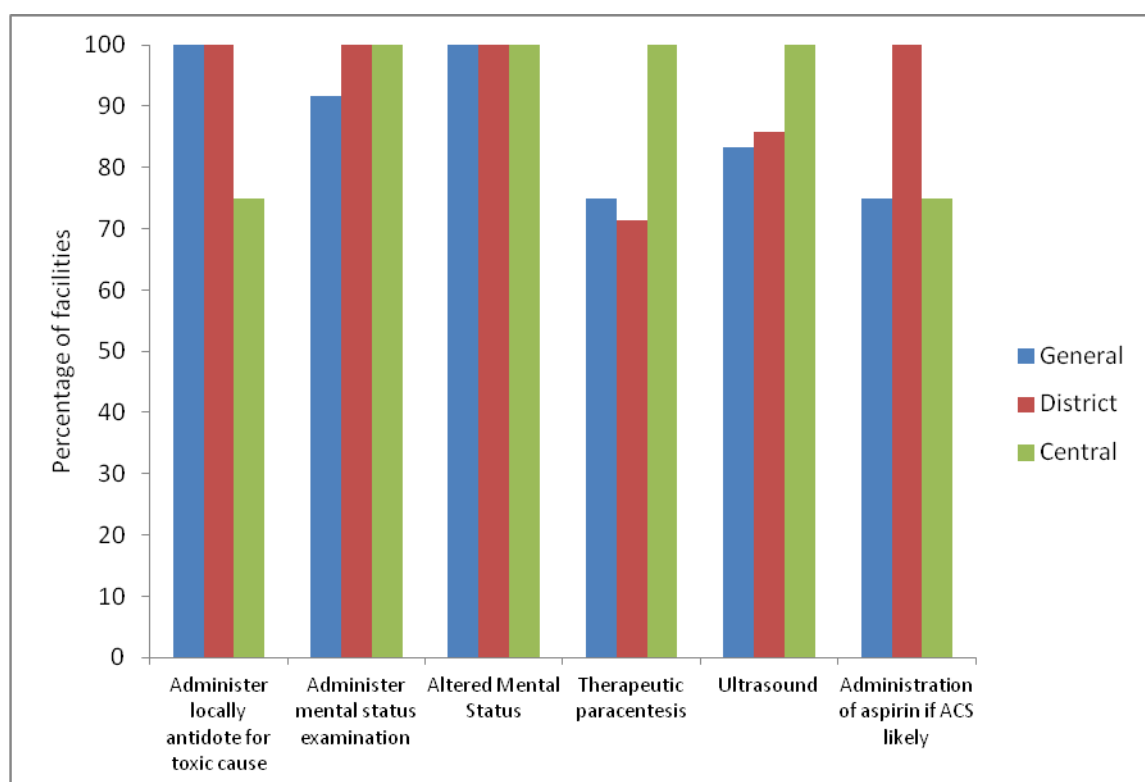


Figure 13: Percentage of facilities performing procedures related to severe pain by health facility type

4.5. Trauma

While all facilities were able to provide appropriate initial wound care, only three quarters had trauma protocols, could perform cervical spine immobilisation, provide cooling care, rabies and tetanus vaccinations and insert a chest tube. None of the facilities were able to perform auto-transfusion from a chest tube (Figure 14). More than 90% of facilities claimed to provide orthopaedic-related procedures such as basic immobilisation.

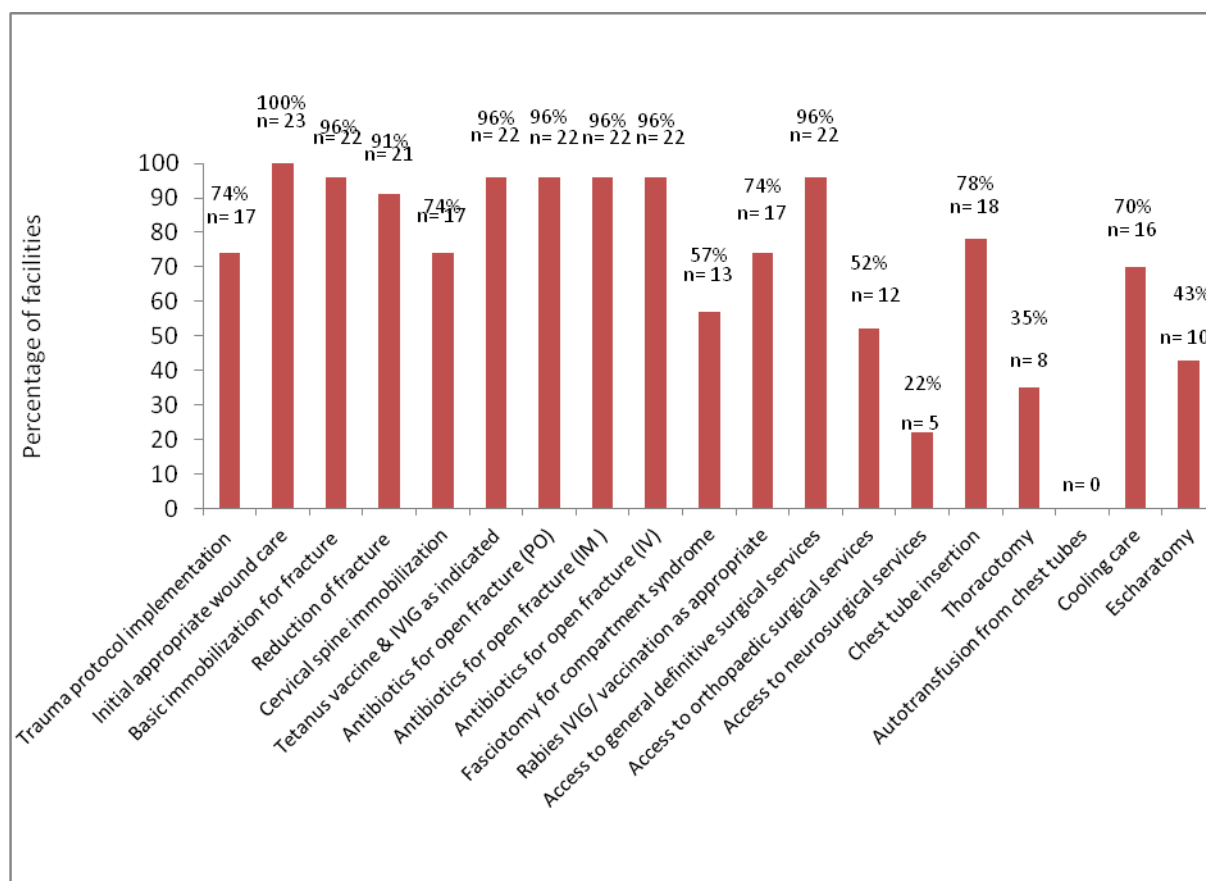


Figure 14: Percentage of health facilities that are able to perform procedures related to trauma

The most frequent reason for not performing trauma-related procedures was no training (n=88), followed by no supplies (n=85), no human resource (n=26), no infrastructure (n=3) and no policy (n=2) (Table 9). Auto-transfusion from chest tubes, thoracotomy, escharotomy and access to neurological services were procedures not available at most district level facilities (Figure 15).

Table 9: Frequency (counts) of reasons for not performing procedures related to trauma

	Trauma protocol implementation	Reduction of fracture	Cervical spine immobilization	Fasciotomy for compartment syndrome	Rabies IVIG/ vaccination as appropriate	Access to orthopaedic surgical services	Access to neurosurgical services	Chest tube insertion	Thoracotomy	Auto-transfusion from chest tubes	Cooling care	Escharotomy	Total
No training	-	1	4	7	1	10	17	3	13	17	3	12	88
No supplies	6	-	1	3	4	10	16	2	9	19	6	9	85
No Human Resource	-	-	-	-	-	10	13	-	1	1	1	-	26
No infrastructure	-	-	-	-	-	-	-	-	1	1	-	1	3
No policy	1	-	-	-	-	-	-	-	-	-	1	-	2
No indication	-	-	-	-	-	-	-	-	-	1	-	-	1

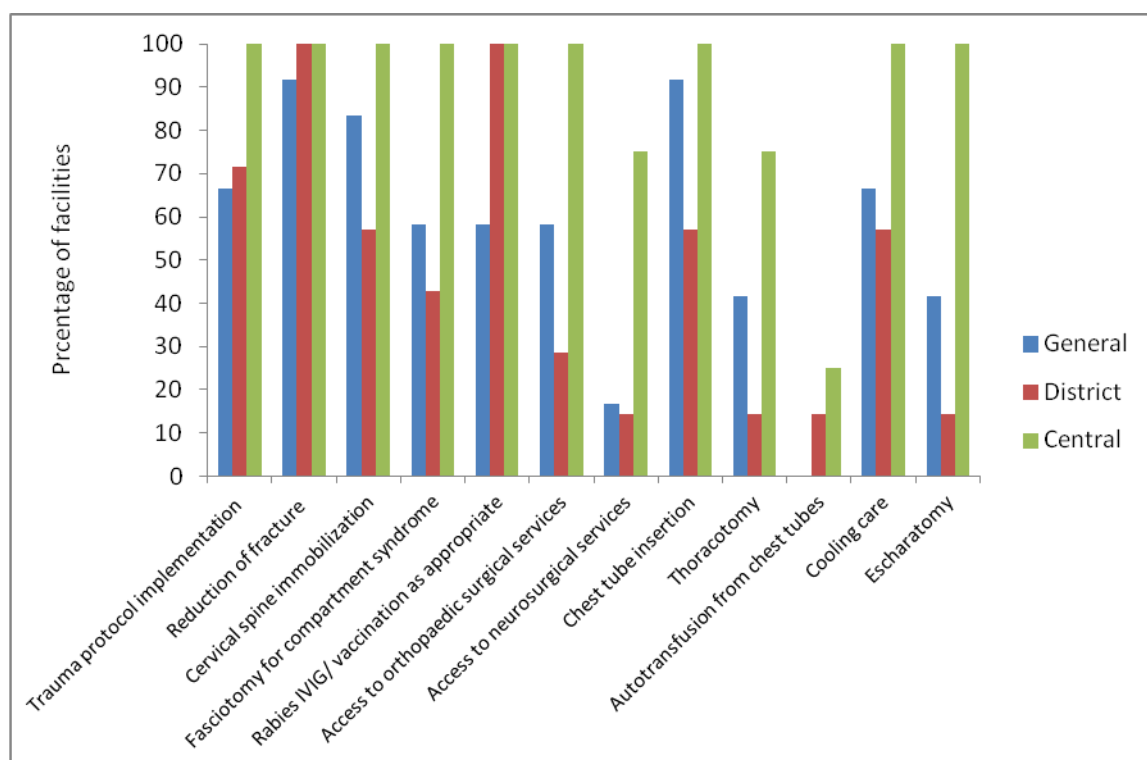


Figure 15: Percentage of facilities performing procedures related to trauma by health facility type

4.6. Maternal Health: Obstructed labour

A total of 21 (91%) health facilities were able to administer uterotonic drugs (i.e. parenteral oxytocin), perform assisted vaginal delivery and had access to surgical services (e.g. caesarean section) (Figure 16), and 96% of facilities were able to perform newborn resuscitation.

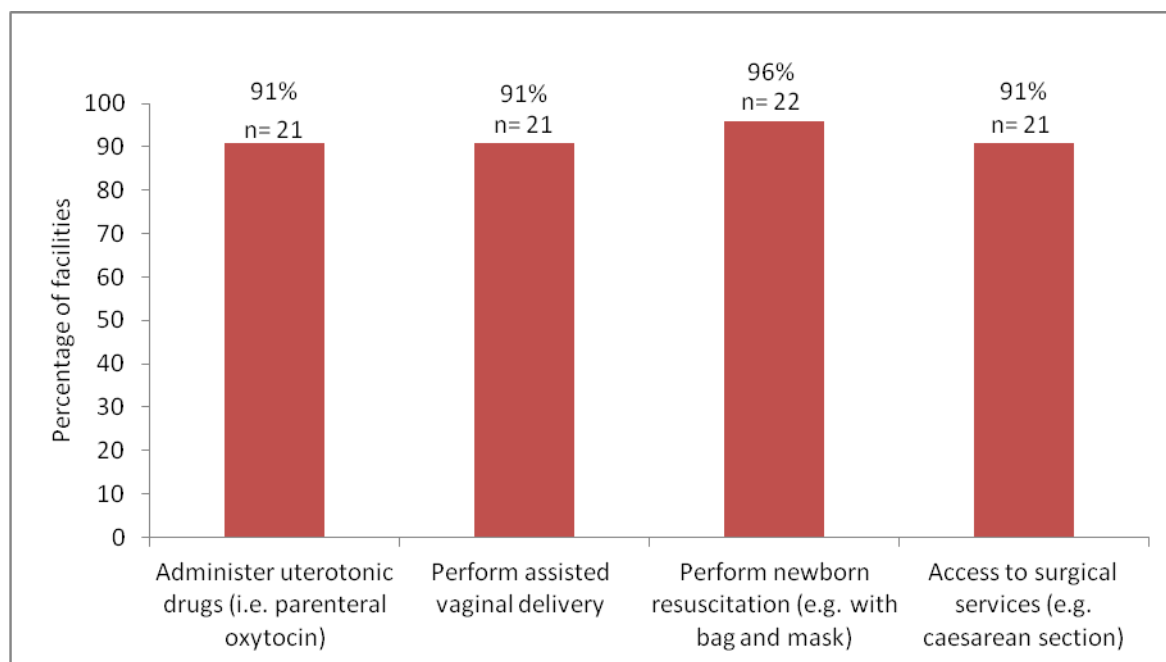


Figure 16: Percentage of health facilities that are able to perform procedures related to obstructive labour

5. DISCUSSION

The most important finding in this study is that the majority of facilities self-reported being able to perform the majority of procedures across all themes in the ECAT. This suggests that they are competent to provide emergency care and that emergency care provision in Zambia was better than expected. However, there were some procedures, which were highly technical or required personnel that had specialised training or equipment (such as surgical airway/cricothyrotomy, mechanical ventilation, interpretation of ECG and cardiovascular defibrillation), that were not commonly performed. These highly technical procedures were available largely at central hospital across all themes; where training was not as big a challenge compared to district and general level. Training challenges at district and general level may be attributed to lack of policies as observed in the findings of this study; whereby only a few district and general hospitals had policies available for the procedures they performed. Policies and guidelines aid in standardising procedures and decision making, particularly in areas where training and senior expertise is limited (37) and are therefore key to sustainability and coordination of emergency care (38). Given that lack of training was identified in this study as a challenge to service delivery, a thorough review of policies and guidelines may still be valuable.

The level of the facility also dictated whether a procedure could be performed or not. For example, supraglottic device placement was not available at general hospitals and surgical airway/cricothyrotomy was not available at district level, but both were available at central level. Similar findings have been observed by De Wulf *et al* (40), who also found that higher-level health facilities like central hospitals were able to perform more procedures due to larger numbers of trained personnel, adequate supplies, better infrastructure and better equipment than lower-level facilities such as clinics or district hospitals. However, there is a need to build capacity at lower-level facilities so that they are able to perform such procedures, since these are first-line access points for patients. Though providing training, equipment and supplies may be increase budgetary allocations at lower level facilities, the overall effect it would have on provision of emergency care to patients outweigh this increase in cost. For example; providing such services at lower levels can improve prognosis of patients and reduce mortality and morbidity through prompt treatment. It would reduce

pressure at central level; leading to improved patient outcomes. It also means that access to such services would not be costly for patients who might otherwise not be able to afford travelling to reach central hospitals.

Shock related procedures and mental status related procedures such as pelvic wrapping and head CT respectively were performed more at central hospitals than district and general hospital mainly because of supplies not being available at district and general hospitals. These procedures may not have been available at lower level facilities because of their high cost but also limited or lack of advocacy to incorporate these onto inventory list of supplies for procurement. Central hospitals are larger with more specialised trained staff in emergency care who may have more advocating will and power to put certain resources on essential lists due to demand of the procedure as opposed to lower level facilities who do not have the specialist to carry out the procedure and therefore may not advocate the need for these supplies. This is further supported by findings of this study which show that training was not a reason for not performing head CT and pelvic wrapping at central hospitals and therefore is suggestive that trained individuals are available to perform these at central level. These findings also highlights systemic challenges such as procurement and uneven distribution of supplies necessary for emergency care at different facility levels that impact on providing and improving emergency care(39). Similarly for trauma related procedure such as access to neurological services, was mainly available at central hospitals owing to the need for a specialist to carry out this procedure; most of which are clustered at central level.

5.1. Reasons for not Performing Emergency Care Procedures

For each of the themes, there were different reasons for not being able to perform a particular procedure as well as differences in the ability of different levels of health facilities to perform procedures. These findings are similar to findings of Coyle and Harrison (14) following an assessment carried out in Sierra Leone. They reported that a lack of formal training was a common reason for not being able to perform procedures related to emergency care across all themes. The majority of facilities assessed were general and

district hospitals and they found that highly-skilled or specialised staff were concentrated in central facilities. However, access to procedures related to emergency care is more frequently required at the district level, as these facilities are usually the first point of contact for trauma or emergency cases (40). Hence, there is need to prioritise and build training capacity at lower level health facilities to improve access to emergency services at lower health care levels, as such interventions can be lifesaving (40).

5.1.1. Training

In the current study, the finding that lack of training is a common reason for not being able to perform procedures is in line with similar assessments performed in Africa. An assessment conducted in Ghana by Choo *et al* (41) found that the most common reason for referring patients from district to regional facilities for procedures relating to obstructed airway and fracture was the lack of trained staff. This shows that additional training in emergency procedures needs to be provided at lower-level facilities to improve the availability of and access to emergency care services (41). Training that is tailored to the needs and requirements of individual facilities can have a positive impact. Thus, the need exists to explore different approaches to provide the necessary training where access to formal training institutions is limited, through, for example, telemedicine, mobile and other information technologies (7).

5.1.2. Supplies

Lack of supplies was another main reason for not being able to perform procedures related to emergency care services. Other studies assessing emergency care services also found limited supplies as a reason for not being able to perform emergency care procedures (39-41). However, a study conducted in Sierra Leone on the assessment of emergency care services found that the majority of facilities had all the necessary equipment (82%) and drugs (76%) available for emergency care related procedures (14). This observation could be due to the inclusion of private facilities in the assessment of Sierra Leone emergency care facilities. In contrast, the current study in Zambia only looked at government facilities. Government facilities have been found to have lower capacity for providing emergency care than private facilities(14). Additionally, training staff or making less-expensive and

sustainable alternatives available can help in overcoming this challenge of limited supplies. As an example, using sheets to wrap an unstable pelvis when pelvic binders are not available can be of great benefit, and in fact has shown to have the same effect on stabilising pelvic fractures as more expensive pelvic stabilisation devices on the market (42). Lack of supplies was also a more common problem at central facilities than at district and general level. This may be attributed to the fact that more complex and specialised procedures are being performed at central level and, thus, more supplies are required (7). Also at central facilities there are higher patient numbers, making it difficult for the central facilities to match the supply and demand needs. Central hospitals are usually located in urban areas, where violence is widespread and typically 40% of the injuries presenting to these facilities are repeat victims of violence (43). There is therefore increased demand and utilisation of resources compared to district and general hospitals where violence is not as common. Poor infrastructure limits an already challenged capacity to provide emergency care in district facilities, leading to increased referrals to higher-level facilities (44). Both large numbers of referrals and unnecessary referrals take up scarce resources. Thakur *et al* (44) looked at referral of patients with orthopaedic injuries in Rhode island, finding that almost 52% of referrals from district to central level centres were unnecessary, and that there was negligible clinical benefit from the transfers (44). If district and general hospital emergency care capacity were improved in terms of human resource, supplies and infrastructure, it is plausible to suggest that transfers to central facilities could be reduced. Providing quality care at the earliest opportunity after injury, and as close as possible to the patient's home, could impact significantly on outcomes. This could also allow for central facilities to sustain resources to utilise for the more severe and complex cases. This finding highlights the limited capacity of the district level of the healthcare system to provide emergency care, and shows the need to build capacity at this level in particular. It also demonstrates the mismatch between supply and demand at central hospitals.

5.1.3. Infrastructure

Infrastructure was found to be a limiting factor for procedures related to emergency care, particularly for procedures such as CT scanning that require dedication of larger spaces. Infrastructure was a common challenge at district and general hospitals, and limited their

ability to perform procedures. Although there are criteria for resource allocation, such as those from the American College of Surgeons (43), these come from high income settings and their applicability to low income countries is not established. Emergency units in low income settings are typically designed without data to determine required capacity and inform resource allocation. Faul *et al* (43) found that infrastructure allocation was very poorly correlated with the actual needs of emergency units. This often results in poorly designed, under-sized, and under-resourced “casualty departments” that struggle with high patient volume and high acuity presentations. Hence, indicating that there’s need to establish criteria for resource allocation and architecture based on local emergency service provision data.

5.1.4. Human Resource

Human resource was not reported as a major reason for not performing emergency procedures, but overall was observed as a greater challenge at general and district than central hospitals. Several factors contribute to human resource challenges in general and district hospitals, primarily because staffing allocations are not correlated with the volume or acuity needs of the department and there are no accepted staffing standards in the region(43). This further highlights the need for policies and procedure relating to emergency care to guide staffing structures, infrastructure, supplies and resource allocations.

5.1.5. Maternal Health

Maternal health was covered in almost all (>90%) facilities and services were available irrespective of the level of health facility. This may be attributed to the prioritisation of maternal health under both the Millennium and Sustainable Development Goals and, thus, most facilities provided it. Similar findings were noted by Levine *et al* (32) when they assessed availability and accessibility of emergency obstetric care in the central province of Zambia. Their study found that the majority of the health centres had the medications (penicillin, oxytocin, ampicillin) necessary for obstetric care, the staff were comfortable performing basic procedures such as basic vaginal deliveries, IV medications and treating

infections but few facilities had the necessary equipment to perform the removal of retained products of conception or assisted vaginal delivery.

This study was unique in that it looked at individual procedures that are performed within different themes of emergency care. It not only provides an overview of the gaps and challenges for which procedures related to emergency care could not be performed, but also provides insight on which specific procedures require strengthening to ensure enhanced and improved provision of emergency care.

5.2. Limitations

Due to travel and logistical constraints, the number of facilities included at each level was not equal within each region. In particular, facilities within rural regions were not well represented within the study.

It was not possible to find the same cadre of staff at each facility for interviewing, which would have strengthened the findings more in terms of comparability.

No private hospitals were included, so any system-wide factors contributing to challenges (such as lack of supplies or limited resource allocation) could not be determined. Including private hospitals would have given a complete system overview. However, the intention of this study was to represent the state sector and including a small number of private hospitals would have confounded the core findings.

The response may be biased as this study only assessed self-reported ability to perform these procedures.

6. CONCLUSION

Overall, the majority of facilities self reported being able to perform most emergency care procedures. Some procedures were not able to be performed, mainly due to lack of training, supplies, poor infrastructure and lack of emergency care procedures. Capacity was most limited at district and general level, and this affected their ability to perform emergency care procedures. It is envisaged that although it may be costly and increase budgetary allocations, building capacity at lower level facilities can improve emergency care across all levels of health facilities, as it will reduce the burden at central level and improve patient outcomes since these are first-line access points for patients.

The findings of this study suggest that emergency care provision within Zambia is better than anecdotally reported. However, this study only assessed self-reported ability to perform these procedures and further research is required to determine the quality of care during performance of these procedures.

Recommendations

The following operational recommendations are made to the Zambian Ministry of Health:

There is a need to establish criteria for facility-level emergency care provision, including:

- The introduction of national emergency care policies and Standard Operating Procedures,
- The development of Infrastructure norms and standards to guide facility design and space allocation,
- Determining optimal Patient-to-staff ratios and regulation of staffing qualification and skill mix for emergency unit personnel,
- The development of Equipment and medication norms and standards, and
- The development of Clinical policies and guidelines for cadre management.

There is a need to establish training in emergency care for all cadres of healthcare staff, including the provision of emergency medicine specialist training to develop a number of emergency care leaders in the country.

Efforts should initially focus on strengthening care at the district hospital level.

Future Research:

The main findings of this study is that the majority of facilities self-reported being able to perform the majority of procedures across all themes in the ECAT. However, some facilities particularly district and general hospitals were not able to perform highly technical and specialised procedures due to either, lack of training or supplies. Future research should therefore focus on a study to determine whether the findings of this research are valid (i.e. can the emergency units actually do what they claim?). Furthermore, a needs assessment in order to determine baseline skills mix, resource allocation, and patient load will help to identify priority areas for attention once policies and norms and standards are developed by the MoH. In addition, future research can be conducted into identifying ways to address specific challenges and then investigating effectiveness of interventions introduced to overcome the challenges.

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8. APPENDIX

Appendix 1: ECAT tool

Emergency Care Assessment Tool



Facility Name: _____ Date _____

Location _____

The survey time will only take approximately one hour.

Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide not to take part or to skip some of the questions, it will not affect your current or future relationship with AFEM. If you decide to take part, you are free to withdraw at any time.

Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Respiratory Failure									
I. Obstructed airway- Can your facility manage an obstructed airway?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Manual manoeuvres ⁴	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Relief of obstruction ⁵	<input type="checkbox"/> Yes								

⁴ Includes head tilt, chin lift, jaw thrust

	<input type="checkbox"/> No								
Use of suction	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Surgical airway	<input type="checkbox"/> Yes <input type="checkbox"/> No								
II. Respiratory Distress - Can your facility manage a patient in respiratory distress?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Rescue breathing	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Three-way dressing	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Insertion of oral airway	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Bag valve mask ventilation	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Supraglottic device placement	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Administer critical therapeutics for reactive airway disease ⁶	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Oxygen administration	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Endotracheal intubation	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Cricothyrotomy	<input type="checkbox"/> Yes								

⁵ Includes abdominal thrusts if conscious, CPR if unconscious, chest thrusts and back blows for infant

⁶ E.g. any bronchodilators, adrenaline, steroids

	<input type="checkbox"/> No								
Non-invasive mechanical ventilation	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Invasive mechanical ventilation	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Shock									
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
<i>I. Haemorrhagic Shock - Can your facility manage a haemorrhagic shock?</i>	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Physical manoeuvres for control of haemorrhage ⁷	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Arterial tourniquet	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Pelvic wrapping	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Packing and suturing for control of haemorrhage	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Peripheral percutaneous intravenous access	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Intraosseus access	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Venous cutdown	<input type="checkbox"/> Yes <input type="checkbox"/> No								

⁷ Direct pressure, pressure bandage, pressure points

Pathogen screened blood transfusion	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Central venous access	<input type="checkbox"/> Yes <input type="checkbox"/> No								
II. Other Shock - Can your facility manage other shock?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
ECG interpretation	<input type="checkbox"/> Yes <input type="checkbox"/> No								
External defibrillation	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Needle decompression of tension pneumothorax	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Administration of adrenaline (for anaphylactic shock)	<input type="checkbox"/> Yes - If yes, circle one: IM IV <input type="checkbox"/> No								
Administration of IV medications that require advance monitoring ⁸	<input type="checkbox"/> Yes - If yes, circle one: IM IV <input type="checkbox"/> No								
Cardioversion	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Pericardiocentesis	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Signal Function	Perform at all	IF	Policies	Human	HCW	Supplies	Infrastructure	No	Other/Comments

⁸ E.g. vasopressors, thrombolytics

	times?	NOT, WHY?		Resources	training	equipment medication		indication	
<i>III. Severe Sepsis/Septic Shock - Can your facility manage severe sepsis/septic shock?</i>	<input type="checkbox"/> Yes <i>- If yes, answer questions below.</i> <input type="checkbox"/> No <i>- If no, please indicate why not.</i>								
Administration of isotonic IV fluids	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Administration of IV antibiotics and/or antimalarials	<input type="checkbox"/> Yes <i>- If yes, circle one:</i> <i>PO IM IV</i> <input type="checkbox"/> No								
Altered Mental Status									
<i>I. Unconscious Patient - Can your facility manage an unconscious patient?</i>	<input type="checkbox"/> Yes <i>- If yes, answer questions below.</i> <input type="checkbox"/> No <i>- If no, please indicate why not.</i>								
Protect from secondary injury ⁹	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Check and/or administer glucose if required.	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Administer insulin for hyperglycemia	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Perform head CT	<input type="checkbox"/> Yes								

⁹ Specifically, is there adequate personnel/infrastructure to monitor blood pressure and avoid hypotension, avoid hyperthermia and cooling if necessary, avoidance of hypoxia, NGT to reduce aspiration risk)

	<input type="checkbox"/> No								
Perform lumbar puncture	<input type="checkbox"/> Yes <input type="checkbox"/> No								
II. Seizure - Can your facility manage seizures?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Administer benzodiazepine	<input type="checkbox"/> Yes - If yes, circle one: PO IM IV <input type="checkbox"/> No								
Administration of parenteral magnesium sulphate for pregnant patient	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Administer locally appropriate antidote for toxic cause ¹⁰	<input type="checkbox"/> Yes <input type="checkbox"/> No								
III. Other - Can your facility manage other altered mental status conditions?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Administer mental status examination	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Management of extremes of temperature	<input type="checkbox"/> Yes <input type="checkbox"/> No								

¹⁰ E.g. antivenom

Severe Pain									
I. General Severe Pain- Can your facility manage patients in severe pain?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Administer opiate based analgesia	<input type="checkbox"/> Yes <input type="checkbox"/> No								
II. Abdominal Pain - Can your facility manage abdominal pain?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Urine dipstick/HCG	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Oral hydration	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Placement of Foley catheter for urinary outlet obstruction	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Therapeutic paracentesis	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Ultrasound	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
III. Chest Pain - Can your facility manage chest pain?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Administration of	<input type="checkbox"/> Yes								

aspirin if ACS likely	<input type="checkbox"/> No								
Chest x-ray	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Trauma									
I. General Trauma - Can your facility manage general trauma?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Trauma protocol implementation	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Initial appropriate wound care ¹¹	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Basic immobilization for fracture	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Reduction of fracture	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Cervical spine immobilization	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Tetanus vaccine & IVIG as indicated	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Antibiotics for open fracture (PO/IM vs IV)	<input type="checkbox"/> Yes - If yes, circle one: PO IM IV <input type="checkbox"/> No								
Fasciotomy for compartment syndrome	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Rabies IVIG/	<input type="checkbox"/> Yes								

¹¹ irrigate with potable water or sterile solution, surgically close clean acute wounds, dress, infection control as needed

vaccination as appropriate	<input type="checkbox"/> No								
Access to general definitive surgical services	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Access to orthopaedic surgical services	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Access to neurosurgical services	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Chest tube insertion	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Thoracotomy	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Autotransfusion from chest tubes	<input type="checkbox"/> Yes <input type="checkbox"/> No								
II. Burns - Can your facility manage burns?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please indicate why not.								
Signal Function	Perform at all times?	IF NOT, WHY?	Policies	Human Resources	HCW training	Supplies equipment medication	Infrastructure	No indication	Other/Comments
Cooling care	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Escharotomy	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Maternal Health									
I. Obstructive Labour - Can your facility manage obstructive labour?	<input type="checkbox"/> Yes - If yes, answer questions below. <input type="checkbox"/> No - If no, please								

	<i>indicate why not.</i>								
Administer uterotonic drugs (i.e. parenteral oxytocin)	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Perform assisted vaginal delivery	<input type="checkbox"/> Yes <i>- If yes, circle one:</i> <i>Routine</i> <i>Vacuum</i> <i>extraction</i> <i>forceps</i> <input type="checkbox"/> No								
Perform newborn resuscitation (e.g. with bag and mask)	<input type="checkbox"/> Yes <input type="checkbox"/> No								
Access to surgical services (e.g. caesarean section)	<input type="checkbox"/> Yes <input type="checkbox"/> No								

Appendix 2: Consent form



Emergency Care Assessment Tool

Facility Name _____

Date _____

Location _____

ECAT Consent Form

You are being asked to take part in a research study that aims to assess the capacity for emergency care in public hospitals using The African Federation for Emergency Medicine (AFEM) Emergency Care Assessment Tool (ECAT). We hope that Zambia will use the findings to develop an improvement plan for emergency care development in those facilities, and to advocate for emergency care in Zambia, we are working closely with the Ministry of Health on this project

If you agree, we will ask you to complete the following survey, based around a series of questions on the ability of the health care facility in managing specific emergency conditions. We do not anticipate any additional risks to you from participating in this study. Any report generated will NOT include information that will make it possible to identify you. The survey will only take approximately one hour.

There are no direct benefits to you by taking part in this survey. We hope to use what we learn and use data from this study which will ultimately help AFEM and Ministry of Health to improve the emergency care system. Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide not to take part or to skip some of the questions, it will not affect your current or future relationship with AFEM. If you decide to take part, you are free to withdraw at any time.

If you have any questions about the survey or the study as a whole, please contact Chancy Chavula at admin@afem.info. Please contact the University of Cape Town, Faculty of Health Sciences, Human Research Ethics Committee at (021)-406-6338 or sumayah.ariefdien@uct.ac.za and Biomedical Research Ethics Committee at (260)-1-250753 or unzarec@unza.zm with any ethical concerns regarding study reference.

Statement of Consent: I have read the above information, and have received answers to any questions I asked. I consent to take part in the study.

Your Signature _____ Date _____

Your Name (printed) _____

Investigators name _____

Signature _____ Date _____

Appendix 3: ECAT Form Instructions

1. This form will take no more than 60 minutes to complete.
2. Enter the facility name
3. Enter the location of the health facility
4. Enter the Date
5. The ECAT form is divided into five main sections:
 - i. Respiratory Failure
 - ii. Shock
 - iii. Altered Mental Status
 - iv. Severe Pain/ Trauma
 - v. Maternal Health
6. There are signal functions under each of the five main sections
7. For each signal function, tick either “Yes” or “No”
8. For signal functions that are ticked “No” ; indicate why that signal function is not available at your facility in the space provided in the form
9. In addition for each signal function provide information in the spaces provided on the form on the following :
 - i. Policies
 - ii. Human Resources
 - iii. Health Care Worker training
 - iv. Supplies equipment medication
 - v. Infrastructure
 - vi. No indication
 - vii. Other/Comment

**Appendix 4: Ethical approval-University of Cape Town Health Research Ethics Committee
(HRECREF: 841/2015)**



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



Room E53-24 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone (021) 406 6338 • Facsimile (021) 406 6411
Email: shunette.thomas@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

02 March 2016

HREC REF: 841/2015

Prof L Wallis
Emergency Medicine
3-floor, OMB

Dear Prof Wallis:

**PROJECT TITLE: FACILITY BASED CAPACITY ASSESSMENT OF EMERGENCY CARE SERVICES
IN PUBLIC HOSPITALS IN ZAMBIA (MSc candidate - Mr C Chavula)**

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee.

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

Approval is granted for one year until the 30th March 2017.

Please submit a progress form, using the standardised Annual Report Form 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)

Please quote the HREC REF in all your correspondence.

We acknowledge that the student Chancy Chavula will also be involved in this study.

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

Yours sincerely

PROFESSOR M. BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.

Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (Doh 2006), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki (2013) guidelines.

HREC REF 841/2015

Appendix 5: Ethical approval-University of Zambia biomedical research ethics committee (UNZABREC)/ Zambia MoH (Ref: 008-01-16)

BIOMEDICAL RESEARCH ETHICS COMMITTEE

Telephone: 260-1-256067
Telegrams: UNZA, LUSAKA
Telex: UNZALU ZA 44370
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Ridgeway Campus
P.O. Box 50110
Lusaka, Zambia

Assurance No. FWA00000338
IRB00001131 of IORG0000774

24th February, 2016.

Our Ref: 008-01-16.

Mr. Chancy Chavula,
University of Cape Town,
African Federation for Emergency Medicine,
P/Bag X24,
Belleville Cape Town,
South Africa.

Dear Mr. Chavula,

RE: RESUBMITTED RESEARCH PROPOSAL: "FACILITY BASED CAPACITY ASSESSMENT FOR EMERGENCY CARE SERVICES IN PUBLIC HOSPITALS IN ZAMBIA" (REF. No. 008-01-16)

The above-mentioned research proposal was presented to the Biomedical Research Ethics Committee on 17th February, 2016. The proposal is approved.

CONDITIONS:

- This approval is based strictly on your submitted proposal. Should there be need for you to modify or change the study design or methodology, you will need to seek clearance from the Research Ethics Committee.
- If you have need for further clarification please consult this office. Please note that it is mandatory that you submit a detailed progress report of your study to this Committee every six months and a final copy of your report at the end of the study.
- Any serious adverse events must be reported at once to this Committee.
- Please note that when your approval expires you may need to request for renewal. The request should be accompanied by a Progress Report (Progress Report Forms can be obtained from the Secretariat).
- Ensure that a final copy of the results is submitted to this Committee.

Yours sincerely,

Dr. S.H Nzala
VICE-CHAIRPERSON

Date of approval: 24th February, 2016.

Date of expiry: 23rd February, 2017.