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Complete List of Authors:	Ardsby, Malin; Linkopings universitet, Emergency Medicine Shayo , Frida ; Kilimanjaro Christian Medical Centre, Emegency Medicine Sakita, Francis M; Kilimanjaro Christian Medical Centre, Emergency Medicine; Kilimanjaro Christian Medical University College Wilhelms, Daniel; Linkopings universitet, Emergency Medicine Moshi, Baraka; Kilimanjaro Christian Medical University College Frankiewicz, Parker; Duke Global Health Institute Silva, Lincoln; Duke Global Health Institute Staton, Catherine; Duke University School of Medicine, Emergency Medicine; Duke Global Health Institute Mmbaga, Blandina; Kilimanjaro Christian Medical Centre; Kilimanjaro Clinical Research Institute Joiner, Anjni; Duke University School of Medicine, Emergency Medicine; Duke Global Health Institute
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Emergency Unit Capacity in Northern Tanzania: A Cross-Sectional Survey

Authors:

*Malin Ardsby[1], *Frida Shayo[2], Francis Sakita (0000-0001-5879-6564)[2,4], Daniel Wilhelms (0000-0001-6347-3970)[1,5], Baraka Moshi[4], Parker Frankiewicz[7], Lincoln Luis Silva (0000-0001-8445-0743)[7], Catherine Staton (0000-0002-6468-2894)[6,7], Blandina Mmbaga (0000-0002-5550-1916)[2,3,4], Anjni P Joiner (0000-0002-8907-182X)[6,7]

*Joint first authors

Affiliations:

[1]Department of Emergency Medicine in Linköping, and Department of Biomedical and Clinical Sciences, Linköping University, SE-581 83, Linköping, Sweden

[2]Kilimanjaro Christian Medical Centre, PO Box 3010, Moshi, Tanzania

[3]Kilimanjaro Clinical Research Institute, Box 2236, Moshi, Tanzania

[4]Kilimanjaro Christian Medical University College, Box 2240, Moshi, Tanzania

[5]Division of Drug Research, Department of Medical and Health Sciences, Linköping University, SE-581 83, Linköping, Sweden

[6]Department of Emergency Medicine, Duke University School of Medicine, 2301 Erwin Road, Durham, NC, USA

[7]Center for Global Emergency Medicine Innovation and Implementation, Duke Global Health Institute, 2301 Erwin Road, Durham, NC, 27710 USA

Correspondence to:

Anjni Joiner

2301 Erwin Road, Duke Hospital North, Box 3096, Durham, NC 27710

anjni.joiner@duke.edu +1 919 687 4087

ABSTRACT

Introduction

Emergency medicine (EM) is a growing field in Sub-Saharan Africa. Characterising the current capacity of hospitals to provide emergency care is important in identifying gaps and future directions of growth. This study aimed to characterise the ability of emergency units (EU) to provide emergency care in the Kilimanjaro region in Northern Tanzania.

Methods

This was a cross-sectional study conducted at 11 hospitals with emergency care capacity in three districts in the Kilimanjaro region of Northern Tanzania assessed in May 2021. Hospital representatives were surveyed by two EM physicians using the Hospital Emergency Assessment tool developed by the World Health Organisation; data was analysed in Excel and STATA.

Results

All hospitals provided emergency services 24 hours a day. Nine had a designated area for emergency care, four had a core of fixed providers assigned to the EU, two lacked a protocol for systematic triage. For Airway and Breathing interventions, oxygen administration was adequate in ten hospitals, yet manual airway manoeuvres were only adequate in six and needle decompression in two. For Circulation interventions, fluid administration was adequate in all facilities, yet intraosseous access and external defibrillation were each only available in two. Only one facility had an ECG readily available in the EU and none were able to administer thrombolytic therapy. For trauma interventions, all facilities could immobilise fractures, yet lacked interventions such as cervical spinal immobilisation and pelvic binding. These deficiencies were primarily due to lack of training and resources.

Conclusion

Most facilities perform systematic triage of emergency patients, though major gaps were found in the diagnosis and treatment of acute coronary syndrome and initial stabilisation manoeuvres of trauma patients. Resource limitations were primarily due to equipment and training

deficiencies. We recommend the development of future interventions in all levels of facilities to improve the level of training.

Keywords: Emergency care capacity; Tanzania; sub-Saharan Africa; HEAT

KEY MESSAGES

What is already known on this topic

Low- and middle-income countries, like Tanzania, bear a disproportionate burden of death and disability due to emergent conditions. Despite advances in emergency medicine training and capacity building in Tanzania, there are still significant gaps in emergency care.

What this study adds

This study assesses emergency units in 11 hospitals in the Kilimanjaro region to determine the current strengths and gaps in the provision of emergency care.

How this study might affect research, practice, or policy

By developing a better understanding of emergency care capacity in the Kilimanjaro region, the results of this study can be used to develop targeted interventions at both the facility and regional levels to begin to bridge the existing gaps in emergency care and improve care coordination between hospitals.

BACKGROUND

Worldwide, up to 30 million deaths occur yearly due to emergencies and the majority of them occur in low- and middle-income countries (LMIC).[1–4] Historically, emergency care has been a neglected issue both at a health system level and in the global health discussion.[5–7] Recently the World Health Organisation and World Health Assembly have called for increased focus on improving emergency care through several recent initiatives.[5,6] Evaluating a system's capacity to provide emergency care in a given region is an important step to identifying gaps and improving care.

The Republic of Tanzania is a lower middle income country in Sub-Saharan Africa with a population of about 55,5 million inhabitants.[7] Like much of sub-Saharan Africa, there is a shortage of trained healthcare professionals, with an estimated 3 doctors and 39 nurses per 100 000 inhabitants in the country.[5] Emergency medicine is a growing field within the country, with increased focus on provision of emergency care, as evidenced by the country's first public emergency department, Muhimbili National Hospital in Dar es Salaam, which opened in 2010. As one of the country's four tertiary referral hospitals, it also houses the country's only emergency medicine residency program, which was created in academic cooperation with programs in South Africa, the United States and Canada.[5] At the moment emergency departments are developing at several hospitals and there is a small but growing number of emergency specialists in the country. In 2011, the Emergency Medicine Association of Tanzania (EMAT) was established and from the Ministry of Health has been given the trusteeship to support and develop emergency care in the country through research and education.[5]

Despite these advances, there are still significant gaps in emergency care. Previous studies assessing emergency surgical capacity and emergency care capacity across the country have identified gaps in infrastructure, human resources, and essential equipment.[4,8]

A need to identify existing gaps in emergency care provision is key in developing targeted interventions at the facility level. The African Federation for Emergency Medicine (AFEM) together with WHO, developed the Hospital Emergency Assessment tool (HEAT) to employ a standardised approach to assessing emergency care capacity in emergency units in low resource settings. The goal of this study was to perform a comprehensive assessment of the

emergency care capacity in the Kilimanjaro region by administering the Hospital Emergency Unit Assessment Tool (HEAT) to the eleven hospitals in the area.

METHODS

Setting

The Kilimanjaro region is located in the north of Tanzania and is the home of one the country's four tertiary referral hospitals, Kilimanjaro Christian Medical Centre (KCMC) located in the city of Moshi. The hospital serves a population of approximately 15 million people from surrounding urban and rural areas.[9] The country has six levels of healthcare facilities: Dispensaries, Health centres, District hospitals (First level facilities), Regional referral hospitals (Second level facilities) and Zonal referral hospitals (Tertiary level facilities) and the National hospital. Healthcare facilities are further categorised by funding source and include Government, Private and Non-governmental organisations (NGO) hospitals.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

Study Design

This was a cross-sectional study of eleven hospitals in the Kilimanjaro region of Northern Tanzania conducted in May 2021 (Table 1). We used an exhaustive sampling approach to select all first, second, and tertiary level hospitals as well as health centres from the following districts: Moshi Municipal Council, Moshi District Council and Hai District Council.

Table 1: List of hospitals in Moshi Municipal, Moshi District and Hai District Councils

Name of facility	Level of Facility	Type of Facility
Moshi Municipal Council		
Moshi Arusha	Health centre	Private hospital
Kilimanjaro First Hospital	First level hospital	NGO
St Joseph's hospital	First level hospital	Private hospital
Mawenzi Regional hospital	Second level hospital	Government hospital

Kilimanjaro Christian Medical Centre (KCMC)	Tertiary hospital	Private hospital
Moshi District Council		
TPC hospital	First level hospital	Government hospital
Kibosho hospital	First level hospital	Private hospital
Kilema hospital	First level hospital	Private hospital
Marangu hospital	First level hospital	Private hospital
Hai District Council		
Hai District hospital	First level hospital	Government hospital
Machame hospital	First level hospital	Private hospital

Hospitals in Moshi Municipal Council were on average 4.9 km (3.7 to 5.3 km) from the nearest higher level facility (Figure 1). Hospitals in Moshi District Council averaged 30.9 km (12.0 to 42.5 km) and 27.5km (25.0 to 30.0 km) for Hai District Council. In this context, we did not include the km to Muhimbili National Hospital in Dar es Salaam where occasionally patients from the tertiary hospital KCMC are referred for neurosurgical or specialised cardiac procedures.

Figure 1: Map of health facilities in Moshi Municipal, Moshi District, and Hai District Councils

When categorising facilities, we elected to use the terminology used in the HEAT tool (health centre, first level, second level, and tertiary level facilities) and further dichotomized facilities into lower level (health centres and first level) and higher level (second level and tertiary level) given the limited number of hospitals in each category.

Data Collection

Researchers contacted each facility in advance in order for the hospital to provide personnel for the day of the interview with knowledge of the clinical practice of the hospital and access to statistical data. Two researchers (MA and FS) performed the interviews, which were conducted in English. One of the researchers, fluent in Swahili and English, was able to translate when

needed. At each facility, between one to four hospital personnel were interviewed. Participants included administrators, senior nurses, and doctors. Additional inclusion criteria were: adult (aged 18 years or older), fluent in English, and employed at the current position for at least one year. Each participant provided verbal and written informed consent. The interviews lasted on average 2 hours and 15 minutes and data was collected using the web-based data collection tool REDCap.[10]

The HEAT Tool (Appendix 1), developed by the WHO in cooperation with the African Federation of Emergency Medicine (AFEM), was used to conduct the surveys. This tool has been used previously in several LMICs to evaluate emergency care provision in facilities.[11–14] It is divided into four sections: 1) Facility characteristics, 2) Human resources, 3) Clinical services and 4) Signal functions. Signal functions focus on assessing if a facility has the resources and skills needed to perform life-saving procedures for specific conditions, including airway, breathing, circulation, and neurologic emergencies as well as sepsis, trauma, and obstetric emergencies. Services and signal functions are rated on a 3-point scale as generally unavailable (1), some availability (2), and adequate (3).

Statistical analysis

The data were analysed using descriptive analysis using Excel (2016) and STATA (version 15). Categorical variables were summarised by use of frequency and percentage, while numerical variables were summarised by use of their respective measure of central tendency.

Ethical approval

Ethical approval was obtained from the Duke University Institutional Review Board (IRB) (Pro000106116), Kilimanjaro Christian Medical Centre IRB (#2486), National Institute for Medical Research (HQ/R.8a/Vol.IX, 3425), and regional and district level permission to recruit health facilities obtained from the relevant authority.

RESULTS

Facility characteristics

Most of the included hospitals (72.7%), including all of the hospitals located outside of Moshi Municipal Council (54.5%) were first level facilities (Table 2). Two of the first level facilities were run by the government as well as the only second level hospital included in the study. The rest of the hospitals were private with public partnership (63.6%) except one, which was run by an NGO.

Table 2. Description of health facilities in the Kilimanjaro region (N=11)

Variable	Frequency	Percentage
Level of facility*		
Lower level facility		
Health Centre	1	9.1
First level hospital	8	72.7
Higher level facility		
Second level hospital	1	9.1
Tertiary hospital	1	9.1
Type of facility		
Government hospital	3	27.3
NGO hospital	1	9.1
Private hospital	7	63.6
Designated room for emergency care		
Yes	9	81.8
No	2	18.2

Functioning high acuity unit (e.g. ICU) beds		
Absent	8	72.7
Present	3	27.3
Population of catchment area		
<200,000	1	9.1
200,000-250,000	4	36.4
>250,000	6	54.5
Number of emergency visit per year		
<200	3	27.3
200-700	3	27.3
≥700	5	45.5
Number of outpatients visit per year		
<20,000	3	27.3
20,000-70,000	7	63.6
>70,0000	1	9.1
Number of admissions per year		
<2,000	2	18.2
2,000- 7000	7	63.6
>7,000	2	18.2

All hospitals were able to provide emergency services 24 hours a day, seven days a week. All hospitals also reported 24/7 access to an operating theatre, and all had access to clean running water and adequate electricity.

All hospitals reported to have triage, however, only six (54.5%) had an adequate designated triage area. Nine of the hospitals had a designated area for emergency care, which ranged from a dedicated bed to an entire department. Only two hospitals had a separate emergency department, the tertiary level hospital and one first level hospital. These two hospitals reported an adequate resuscitation area. All others had some availability, for example a bed in the OPD or ward for resuscitation.

Only three hospitals (27.3%) reported to have a high acuity unit, with the number of dedicated beds ranging from 1 to 20. The majority of these were located in Moshi Municipal Council (84.0%). Only two hospitals had adequate isolation rooms for infectious diseases whereas two had none and the rest had some availability. Only one hospital in the region had a CT scanner available (Table 3).

Table 3. Equipment and diagnostic test availability in the facilities N(%)

	Adequate	Some Availability	Unavailable
Equipment			
Oxygen in the Emergency unit	8(72.7)	3(27.3)	0
Fully equipped crash trolley	2(18.2)	8(72.7) [a]	1(9.1)
Cardiac monitoring in the emergency unit	1(9.1)	5(45.5) [b]	5(45.5)
ECG in the emergency unit	1(9.1)	7(63.6) [c]	3(27.3)
Ultrasonography in the emergency unit	2(18.2)	8(72.7) [c]	1(9.1)

X-ray in the hospital	9(81.8)	0	2(18.2)
CT scan in the hospital	1(9.1)	0	10(90.9)
Diagnostic tests			
Arterial blood gas	0	2(18.2)	9(81.8)
Haemoglobin	0	10(90.9)	1(9.1)
Troponin	0	1(9.1)[d]	10(90.9)
Glucose	9(81.8)	2(18.2)[d]	0
Malaria rapid diagnostic testing	4(23.7)	8(72.7)[d]	0

Type of oxygen supply: Pipe 9.1%, concentrator 54.5%, oxygen tank 100%,
Possible to call for a tank when needed to the emergency unit 90.9%

[a]: Some availability means some drugs or equipment are lacking or the use of a cupboard instead of a trolley

[b] Some availability means somewhere else in the hospital like in a ward or some are broken and not enough

[c] Some availability means somewhere else in the hospital like in the radiology department

[d] Some availability means somewhere else in the hospital like in the laboratory, or sometimes out of stock

Human resources

Four of the facilities (36.4%), namely both the two higher level facilities and two of the first level hospitals reported to have a core of fixed non-rotating providers permanently assigned to the emergency unit (Appendix 2). The tertiary hospital had 32 nurses, 13 licensed medical officers and three emergency medical specialists. They also had a core of rotating interns. The secondary hospital had 19 nurses, 7 mid-level providers/advanced practice nurses and 11 medical officers of which 8 were licensed and no specialist. One of the first level facilities had 8 nurses, 4 mid-level providers/advanced practice nurses and one trauma specialist and the seconded of the first level facilities had 6 nurses and 6 licensed medical officers and no specialist.

All the other hospitals (63.6%) had rotating staff of nurses, mid-level providers and medical officers to the emergency unit; none of these hospitals had any rotating specialist.

Consulting services from anaesthesia were available in all hospitals except the health centre, though in all facilities except the tertiary hospital the consultant was a midlevel provider in

anaesthesia as a result of the agreement on task shifting in the country due to shortage in doctors (15).

Clinical services

All hospitals except the health centre and one first level hospital acknowledged that there were regulations or protocols mandating that acutely ill or injured patients are clinically triaged prior to registration (Appendix 3). All stated that vital signs are measured in the triage area. Six of the hospitals said they used a formal triage system (54.5%) but only two stated that time targets were tracked regularly (18.2%). Only one hospital reported specific triage protocols for children <5 years of age (9.1%) and no one reported specific triage protocols for pregnant women. Pregnant women and small children were systematically referred to the nearby maternity ward. All hospitals except two stated that they had a protocol for systemic triage that ensured patients to be seen in order of acuity (81.8%).

All hospitals except two reported to have protocols for initial approach to ABCDs (81.8%), only one had a trauma checklist (9.1%) and five had a medical resuscitation checklist (45.5%).

Signal functions

Figure 2: Signal function availability across higher and lower level facilities

Facilities were divided into higher level facilities, which included the tertiary hospital and the second level hospital, and lower level facilities, which included the health centre and all first level hospitals (Figure 2). For all signal functions, most services and treatments were typically reported as adequate or with some availability across both higher level and lower level facilities (Appendix 4). For Airway and Breathing interventions, all facilities generally noted a limited ability to place a supraglottic airway device, creation of a surgical airway, to use non-invasive and invasive mechanical ventilation, and to perform needle decompression for a tension pneumothorax.

Circulation interventions were reported as generally available in most facilities with the exception of intraosseous access, external defibrillation or cardioversion, and external cardiac pacing. No facility reported the ability to perform pericardiocentesis or administer thrombolytic therapy in the emergency unit. The ability to treat neurologic emergencies varied significantly by facility, however, all facilities indicated they were able to administer glucose for hypoglycemia and the majority could adequately perform mental status examinations. Management of extreme temperatures and protection of seizure patients from secondary injury seemed to vary the most among the facilities.

Most interventions for sepsis were reported to be able to be performed in all facilities, with the exception of IV vasopressor use. All facilities stated they could provide fracture immobilisation and initial wound care for trauma interventions. Most indicated the ability to administer IV antibiotics for open fractures, perform closed fracture or dislocation reductions, and administer a tetanus vaccine. The ability to place a three-way dressing for a sucking chest wound or perform a fasciotomy were typically reported as unavailable at most facilities. Obstetric interventions were also highly variable between facilities, with the most variability among those facilities able to perform neonatal resuscitation.

DISCUSSION

In this study, we achieved a comprehensive assessment of the emergency care capacity of all hospitals located in three districts in the Kilimanjaro region of northern Tanzania. We found significant variation in dedicated space for emergency care treatment and assessment with only two hospitals having dedicated emergency departments, two hospitals with no facilities to care for emergency patients outside of the wards, and the remainder with access to a designated area for emergencies that was not classified as a separate department. Higher level facilities were located in the urban areas whereas the rural areas only had first level facilities. Like previous studies in other similar settings, we found that the higher level facilities were often better equipped.[4,12,14,16] For example, the only CT scanner in the study area was located in the tertiary hospital. We also found that this hospital was the only one which employed emergency medicine specialists. Most services and treatments for all signal functions were reported as adequate or with some availability across both higher level and lower level facilities. Similar to other emergency medicine capacity assessments in LMICs, we note that resource

limitations with respect to equipment and training deficiencies were the primary drivers of gaps in adequate emergency care provision.[4,8,11–13,16,17]

In our study all facilities reported to have a triage area, and six had a separately designated space. This represents a significant change compared to a previous study in Tanzania from 2013, which demonstrated that only 30% of the facilities had a triage area.[4] Moreover, nine out of the eleven hospitals stated that they had a protocol for systematic triage to ensure that patients were seen in order of acuity. Lack of adequate triage is common in LMICs and represents a significant challenge in addressing emergency conditions in hospitals.[11,13,18,19] Triage is a core function to provide timely care and triage systems in the emergency unit, in which a brief history and vital signs are obtained to sort patients to be seen in order of acuity, can improve care and reduce preventable deaths.[1,14] Our findings demonstrate a significant improvement in triage protocols compared to prior work in Tanzania, which found that only 13% of the hospitals that had triage guidelines for adults.[4] Whether this represents an overall change to the country or findings specific to this region is unclear.

We are experiencing an epidemiologic change in which the developing world has a growing number of noncommunicable diseases.[17,19,20] Cardiovascular diseases are underdiagnosed in sub-Saharan Africa and acute manifestations of these, such as myocardial infarction and cardiac arrest, result in a higher burden of deaths.[21,22] Reflective of this pattern, we noted significant gaps in the ability of hospitals to provide diagnostic and therapeutic cardiac interventions. Only one facility had access to an ECG in the emergency unit and three hospitals reported no ECG anywhere in the facility. Troponin was only available in one of the facilities, thrombolytic treatment for myocardial infarction was not available anywhere, and external defibrillation and pacing were also limited in availability. This lack of equipment and treatment availability for cardiovascular diseases has also been noted in other LMIC settings.[12,16,17,21,23] A qualitative interview study of physicians and clinical officers in Tanzania in 2017 indicated similar results regarding acute coronary syndrome (ACS) management in which lack of guidelines and poorly equipped facilities including both diagnostic equipment and treatment were highlighted.[23] Moreover, none of the facilities evaluated were able to provide percutaneous cardiac intervention (PCI) or rapid administration of fibrinolysis and the closest hospital providing these therapies was in Dar Es Salaam.

A previous assessment of the prevalence of acute myocardial infarction (AMI) in the emergency department at our tertiary hospital found an underrecognition of the diagnosis both for patients and for caregivers.[21] Up to 90% of the AMI cases were estimated to be under-diagnosed and a 30-day follow-up showed a more than 40% mortality in an AMI.[21] The lack of equipment, training, and treatments that we found indicate barriers to diagnosing and treating ACS, potentially contributing to the high mortality rate. Further focus on diagnostics could improve underrecognition of ACS and improvement of low-cost interventions and appropriate referral may provide treatment benefits when more advanced treatments are unavailable.[21,24]

Another area for improvement was seen in initial trauma interventions. According to WHO guidelines essential trauma care includes the initial stabilisation of a trauma victim in order to prevent mortality and morbidity.[25] To this end, interventions such as cervical spine immobilisation, manual airway manoeuvres, and pelvic binder administration were limited in availability across much of the area due to lack of training and resources. Additionally, of all of the hospitals, only one had an available CT scanner. Knowing that a majority of deaths related to trauma occur in LMICs,[5,22,25] and that motor vehicle collisions are increasing in the Kilimanjaro area,[26,27] our findings identify important gaps in addressing emergency trauma care in the area. Several other studies measuring emergency care capacity in LMICs have identified suboptimal trauma management as well.[12,14,17,25] A prior study in Muhimbili National referral hospital found that most trauma patients transferred from both first and second level hospitals did not receive simple initial stabilisation manoeuvres such as cervical spine immobilisation or adequate splinting for extremity injuries.[25] These findings are reflective of our study. Simple training interventions and provision of basic equipment for trauma resuscitation in low resource settings have been shown to improve mortality and may have a role in this setting.[3,12]

The WHO has developed a Basic Emergency Care course (BEC) to improve emergency care in low-resource settings. A recent intervention in two district hospitals in Uganda aimed to improve emergency care provision through implementing the BEC course as well as introducing a triage protocol, two checklist protocols and a resuscitation area guidance. Through these interventions, they successfully reduced deaths due to emergencies by 50%.[28] Interventions like the BEC would likely improve the emergency care in this region significantly, particularly in facilities unable to provide basic emergency interventions.

On a larger scale, the limited availability of certain diagnostics highlights the need for strong referral networks for time-dependent emergencies, such as STEMI and trauma. Development of referral networks have been recommended to coordinate care centres and reduce the time to access life-saving treatment and have demonstrated improvements in mortality as well as timely access to care.[29–32] In settings such as in our study, where for example there is only one hospital with a CT scanner, it is imperative that appropriate referrals are made to higher level facilities based on a predefined network.[24] A comprehensive approach should be taken when developing these systems of care, including development of unified clinical practice guidelines, education of clinicians, quality improvement, and registries.[24,31,33]

We note several limitations in this study. First, formal statistics at several of the hospitals were unavailable and many quantitative reports of facility characteristics were estimated by survey participants. There was generally no record keeping of specific emergency cases or emergency surgeries. Only the two hospitals with an emergency department maintained these records. Records of outpatient visits were kept in all facilities and emergency cases were included in these numbers if they were not admitted. If admitted, then they were included in admission records. Therefore, in these facilities, interviewees provided estimations of the numbers of emergency patients. We note that some variability in responses may be due to alternate interpretations of what constitutes an emergency patient. Second, recall bias likely impacted the recollections of the interviewees with respect to multiple questions. The interviewees were mainly employees with significant knowledge of the hospital, such as a medical officer in charge. However, in some facilities, the available survey respondents were in alternate roles or less experienced, which may have biassed the answers. Thirdly, all facilities referred all cases of obstetric or neonatal emergencies to the maternity ward, so these questions were overall challenging to answer for most of the participants. Most of the emergency surgeries were c-sections and these were excluded from the emergency surgery data collection. Finally, these results may not be generalisable to other areas of the country, however, our exhaustive sampling approach provided representation from all levels of hospitals in the region, therefore strengthening the study.

CONCLUSION

In this comprehensive assessment of eleven hospitals in northern Tanzania we found that most signal function performances were reported as adequate or had some availability in all levels of

the facilities. We see a marked improvement in facility capacity to triage emergency patients compared to a previous in-country assessment performed eight years ago. Like other studies in sub-Saharan Africa and LIMCs we found deficiencies in equipment and training. The major shortfalls were found in diagnosing and treatment of acute coronary syndrome and initial stabilisation manoeuvres in trauma patients.

We see a need for stakeholders to address these issues and recommend future interventions in all levels of facilities specifically focused on training interventions such as the WHO BEC course as well as a focus on cardiovascular disease-specific training such as ECG interpretation. Focusing additional resources and equipment for lower level facilities may provide the most impact as they typically are the first to encounter patients and often less equipped than higher level facilities. Finally, the development of referral systems of care for time-dependent emergencies as a future step may best utilise limited resources.

Contributors: MA and FS collected and analysed the data, drafted and revised the paper. They are both guarantors. APJ, FS, DW, CS and DW designed the study and revised the paper. APJ initiated the collaborative project and monitored data collection. She is also a guarantor. LLS, PF, and BM analysed the data and revised the paper.

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Data sharing statement: All data generated or analysed during this study are available from the Kilimanjaro Christian Medical Centre upon reasonable request from the corresponding author.

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Footnotes

Patient consent for publication: Not required.

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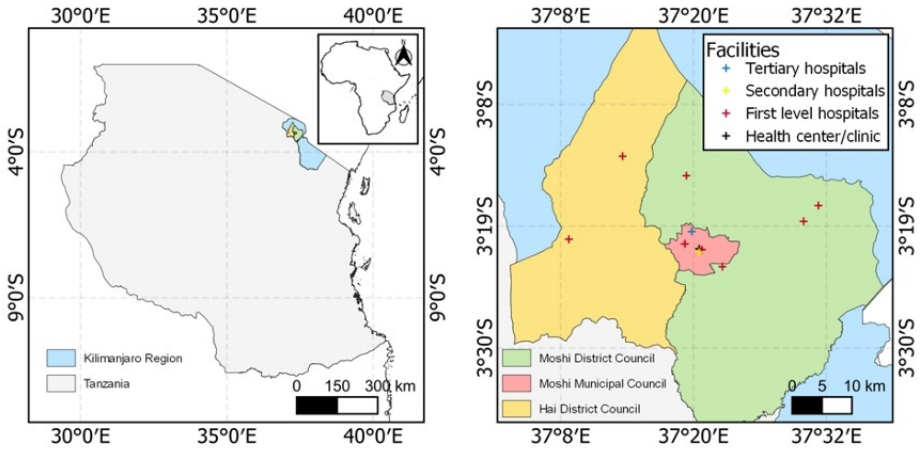

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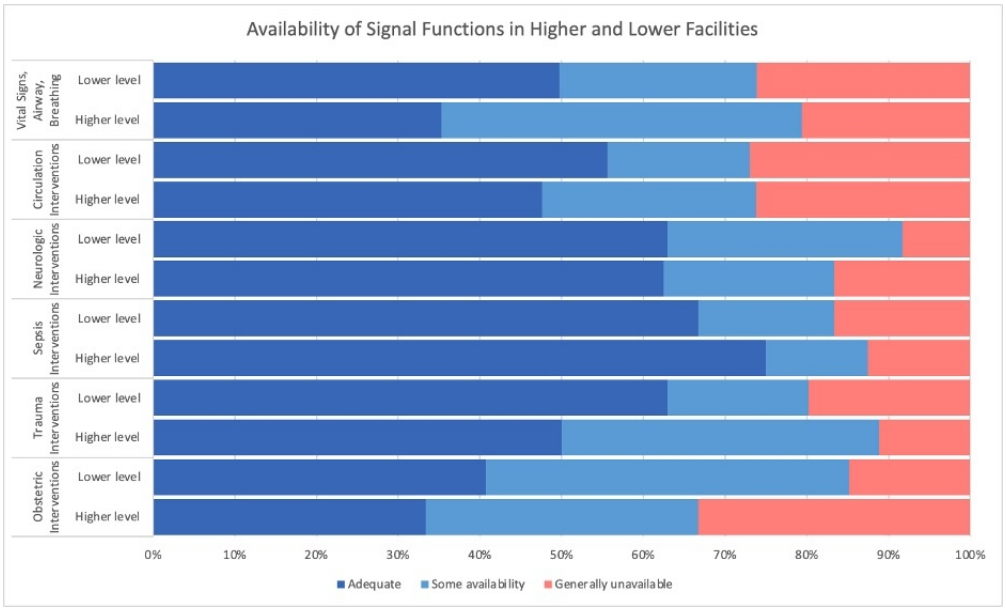

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Supplemental material:

Full results

Human Resources Performances	**Yes, N (%)**		**No, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**
EMERGENCY CARE CLINICAL PROVIDERS				
Core of fixed providers permanently assigned to the emergency unit	2 (100.0)	2 (22.2)	0 (0.0)	7 (77.8)
	Average Number of Providers, N		**Average Number of Licensed or Certified Providers, N**	
	Higher level	**Lower level**	**Higher level**	**Lower level**
Number of <u>non-rotating</u> providers assigned to emergency unit				
Nurses/nurse midwives	25.5	1.6	18.0	1.6
Mid-level provider or advance practice nurses	3.5	0.4	3.5	0.4
Doctors without specialist training	12.0	0.8	10.5	0.8
Emergency medicine specialists	1.5	0.0	1.5	0.0
Other specialist doctor	0.0	0.1	0.0	0.1
Number of <u>rotating</u> providers assigned to emergency unit				

Nurses/nurse midwives	0.5	14.1	0.0	14.1
Mid-level provider or advance practice nurses	0.0	9.2	0.0	9.2
Doctors without specialist training	7.0	5.7	0	5.7
Emergency medicine specialists	0.0	0.0	0.0	0.0
Other specialist doctor	0.0	0.0	0.0	0.0

CONSULTING SERVICES AVAILABLE TO THE EMERGENCY UNIT

	Adequate, N (%)		**Some Availability, N (%)**		**Generally unavailable, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**	**Higher level**	**Lower level**
Consulting Service						
General Surgery	2 (100.0)	4 (44.4)	0 (0.0)	3 (33.3)	0 (0.0)	2 (22.2)
OB/GYN	2 (100.0)	3 (33.3)	0 (0.0)	2 (22.2)	0 (0.0)	4 (44.4)
Orthopaedics	2 (100.0)	4 (44.4)	0 (0.0)	3 (33.3)	0 (0.0)	2 (22.2)
Anaesthesia	0 (0.0)	0 (0.0)	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Paediatrics	2 (100.0)	1 (11.1)	0 (0.0)	2 (22.2)	0 (0.0)	6 (66.7)
Psychiatry	1 (50.0)	2 (22.2)	1 (50.0)	2 (22.2)	0 (0.0)	5 (55.6)
Other Specialty	1 (50.0)	3 (33.3)	1 (50.0)	4 (44.4)	0 (0.0)	2 (22.2)

Clinical Services Performances	Average Proportion		Don't Know, N			
	Higher level	Lower level	Higher level		Lower level	
ACCESS						
Proportion of patients with emergency conditions brought to the facility by ambulance with formally trained prehospital care providers	0.325	0.065	N/A		1 facility	
	Yes, N (%)		No, N (%)		No Data, N (%)	
	Higher level	Lower level	Higher level	Lower level	Higher level	Lower level
Presence of regulations and/or protocols mandating that acutely ill or injured patients are clinically triaged prior to being required to register	2 (100.0)	7 (77.8)	0 (0.0)	1 (11.1)	0 (0.0)	1 (11.1)
Requirement of payment prior to provision of initial emergency care	0 (0.0)	2 (22.2)	2 (100.0)	7 (77.8)	0 (0.0)	0 (0.0)
Presence of an electronic system for registration	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
TRIAGE						
Vital signs measured in triage area	2 (100.0)	9 (100.0)	0 (0.0)	0 (10.0)	0 (0.0)	0 (0.0)
Formal triage system	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)	0 (0.0)	0 (0.0)

Time targets for each triage category	1 (50.0)	2 (22.2)	0 (0.0)	3 (33.3)	1 (50.0)	4 (44.4)
Regular tracking of compliance with time targets	0 (0.0)	2 (22.2)	0 (0.0)	1 (11.1)	2 (100.0)	6 (66.7)
Specific triage protocols for children <5 years of age	0 (0.0)	1 (11.1)	1 (50.0)	4 (44.4)	1 (50.0)	4 (44.4)
Specific triage protocols for pregnant women	0 (0.0)	0 (0.0)	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)
GUIDELINES, PROTOCOLS, AND CHECKLISTS						
	Yes, N (%)		**No, N (%)**			
	Higher level	**Lower level**	**Higher level**		**Lower level**	
Written protocols						
Presence of any written protocols.	2 (100.0)	9 (100.0)	0 (0.0)		0 (0.0)	
	Yes		**No**			
	Higher level	**Lower level**	**Higher level**		**Lower level**	
Protocol for systematic triage that ensures patients are seen in order of acuity	2 (100.0)	7 (77.8)	0 (0.0)		2 (22.2)	
Syndromic surveillance guidelines with links to public health officials for case definition and reporting	2 (100.0)	8 (88.9)	0 (0.0)		1 (11.1)	

Clear protocol for communication with hospital administration during times of overcrowding	0 (0.0)	4 (44.4)	2 (100.0)	5 (55.6)
Emergency-unit-specific emergency response protocol, including protocol for mass casualty incidents	1 (50.0)	4 (44.4)	1 (50.0)	5 (55.6)
Clinical management protocols				
Protocol for initial approach to ABCDs (airway, breathing, circulation, basic neurologic function)	2 (100.0)	7 (77.8)	0 (0.0)	2 (22.2)
Trauma care checklist	1 (50.0)	0 (0.0)	1 (50.0)	9 (100.0)
Medical resuscitation checklist	1 (50.0)	4 (44.4)	1 (50.0)	5 (55.6)
Protocol for neonatal resuscitation	0 (0.0)	6 (66.7)	2 (100.0)	3 (44.4)
Protocol for volume resuscitation of children and adults	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Protocol for adjusting interventions for malnourished patients	2 (100.0)	5 (55.6)	0 (0.0)	4 (44.4)
Protocol for post-exposure prevention of STI/HIV, emergency contraception, and counselling	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Protocol for management of labour and delivery in low risk women	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)
	Yes, N (%)		**No, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**

Condition-specific management protocols				
Asthma exacerbation	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Pneumonia	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Maternal haemorrhage	1 (50.0)	7 (77.8)	2 (50.0)	2 (22.2)
Sepsis	1 (50.0)	4 (44.4)	1 (50.0)	5 (55.6)
Diabetic ketoacidosis	2 (100.0)	5 (55.6)	0 (0.0)	4 (44.4)
Other condition	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Admission or discharge protocols				
Acuity-based internal transfer protocols to OR or ICU	1 (50.0)	3 (33.3)	1 (50.0)	6 (66.7)
Protocol for timely disposition from the emergency unit	2 (100.0)	4 (44.4)	0 (0.0)	5 (55.6)
Protocol for conveying information about discharge or disposition to the patient	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Hand-over protocols when transferring patients from one care provider to another	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Outside transfer protocols				
Condition-specific transfer or referral protocols	1 (50.0)	6 (66.7)	1 (50.0)	3 (33.3)

Communication with receiving facility prior to transfer of patients with emergency conditions	1 (50.0)	9 (100.0)	1 (50.0)	0 (0.0)
Safety protocols				
Infection prevention and control protocols	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
Protocol for post exposure prophylaxis for health care workers	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Security protocols to protect staff, patients, and infrastructure from violence.	0 (0.0)	6 (66.7)	2 (100.0)	3 (33.3)
Protocol for managing hazardous exposures (including designated decontamination area)	0 (0.0)	3 (33.3)	2 (100.0)	6 (66.7)
Containment and disposal of sharps and biomedical waste	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
Plan to ensure emergency unit staff and patient safety if an incident occurs within the emergency unit (including space, transport, communications)	0 (0.0)	4 (44.4)	2 (100.0)	5 (55.6)
QUALITY IMPROVEMENT IN THE EMERGENCY UNIT				
Systematic process for collecting patient data that links condition, management and outcomes (e.g., trauma registry)	2 (100.0)	4 (44.4)	0 (0.0)	5 (55.6)
Regular meetings convened to use clinical data for quality improvement (e.g., morbidity and mortality conferences, preventable death panels)	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)

Tracking (e.g., clinical audit) to ensure that quality improvement actions (e.g., corrective action) are implemented after review meetings	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
Clinical document template (e.g., standardised clinical chart)	2 (100.0)	7 (77.8)	0 (0.0)	2 (22.2)
Visit to this emergency facility by a supervisor from outside the facility within the last 6 months	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Documentation from the most recent external supervisory visit	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)

	Yes, N (%)		**No, N (%)**		**No Data, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**	**Higher level**	**Lower level**
Document provides feedback or comments on some aspect of emergency services	2 (100.0)	8 (88.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)

Signal Function Performances	**Adequate, N (%)**		**Some Availability, N (%)**		**Generally unavailable, N (%)**	
	Higher level	Lower level	Higher level	Lower level	Higher level	Lower level
VITAL SIGNS, AIRWAY, BREATHING						
Vital signs						
Vital signs triage area	1 (50.0)	9 (100.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)
Vital signs emergency unit	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)

Airway						
Manual airway manoeuvres	0 (0.0)	6 (66.7)	2 (100.0)	3 (33.3)	0 (0.0)	0 (0.0)
Use of suction	1 (50.0)	2 (22.2)	1 (50.0)	7 (77.8)	0 (0.0)	0 (0.0)
Placement of oro- or nasopharyngeal airway device	1 (50.0)	6 (66.7)	1 (50.0)	2 (22.2)	0 (0.0)	1 (11.1)
Placement of supraglottic device	0 (0.0)	1 (11.1)	0 (0.0)	4 (44.4)	2 (100.0)	4 (44.4)
Endotracheal intubation	2 (100.0)	3 (33.3)	0 (0.0)	4 (44.4)	0 (0.0)	2 (22.2)
Creation of surgical airway	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)	2 (100.0)	8 (88.9)
Breathing						
Saturation measured at triage	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)
Saturation measured in emergency unit	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Bronchodilator administered	1 (50.0)	4 (44.4)	1 (50.0)	3 (33.3)	0 (0.0)	2 (22.2)
Administration of oxygen	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Ventilation with BVM	1 (50.0)	8 (88.9)	1 (50.0)	0 (0.0)	0 (0.0)	1 (10.0)
Non-invasive mechanical ventilation	0 (0.0)	1 (11.1)	1 (50.0)	0 (0.0)	1 (50.0)	8 (88.9)
Invasive mechanical ventilation	0 (0.0)	0 (0.0)	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)
Needle decompression of tension ptx	0 (0.0)	2 (22.2)	1 (50.0)	1 (11.1)	1 (50.0)	6 (66.7)
Placement of chest tube	0 (0.0)	3 (33.3)	2 (100.0)	2 (22.2)	0 (0.0)	4 (44.4)
CIRCULATION INTERVENTIONS						
Volume Resuscitation						

Administration of oral rehydration	1 (50.0)	9 (100.0)	0 (0.0)	0 (0.0)	1 (50.0)	0 (0.0)
Peripheral IV placement	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Intraosseous access	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	9 (100.0)
Venous cutdown	0 (0.0)	5 (55.6)	1 (50.0)	2 (22.2)	1 (50.0)	2 (22.2)
Central venous line placement	0 (0.0)	2 (22.2)	1 (50.0)	6 (66.7)	1 (50.0)	1 (11.1)
IV fluid administration	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Adjustment of fluid resuscitation for malnutrition or severe anaemia	2 (100.0)	8 (88.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)
Urinary catheter placement	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Control of Bleeding						
External control of haemorrhage	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Wound packing and/or suture to control bleeding	2 (100.0)	7 (77.8)	0 (0.0)	2 (22.2)	0 (0.0)	0 (0.0)
Tourniquet placement	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Pelvic binding placement	0 (0.0)	2 (22.2)	2 (100.0)	3 (33.3)	0 (0.0)	4 (44.4)
Safe transfusion of blood performed	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Point of care ultrasound performed	0 (0.0)	1 (11.1)	1 (50.0)	6 (66.7)	1 (50.0)	2 (22.2)
Cardiac Interventions						
Pericardiocentesis performed	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	9 (100.0)
External defibrillation and/ or cardioversion performed	1 (50.0)	1 (11.1)	0 (0.0)	3 (33.3)	1 (50.0)	5 (55.6)

External cardiac pacing performed	0 (0.0)	0 (0.0)	1 (50.0)	2 (22.2)	1 (50.0)	7 (77.8)
Adrenaline available for administration	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
ECG performed and interpreted	0 (0.0)	4 (44.4)	1 (50.0)	3 (33.3)	1 (50.0)	2 (22.2)
Aspirin administered for ischemia	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Thrombolytic administration for MI	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	9 (100.0)
Unconscious Patient						
Point of care glucose testing for unconscious patients	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Glucose administered for hypoglycemia	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Lumbar puncture performed in unconscious patient	0 (0.0)	3 (33.3)	0 (0.0)	4 (44.4)	2 (100.0)	2 (22.2)
Seizure						
Protection from secondary injury of patient with seizure	1 (50.0)	3 (33.3)	0 (0.0)	4 (44.4)	1 (50.0)	2 (22.2)
Benzodiazepine administered for seizure	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
IV Magnesium admin for eclampsia	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Other						
Mental status examination performed	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Management of extreme temperature	1 (50.0)	2 (22.2)	0 (0.0)	3 (33.3)	1 (50.0)	4 (44.4)
Safe physical restraint performed when needed	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Medication administered for agitation	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)

Procedural sedation performed	1 (50.0)	2 (22.2)	1 (50.0)	6 (66.7)	0 (0.0)	1 (11.1)
Relevant antidote administered for toxic exposure	0 (0.0)	0 (0.0)	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
SEPSIS INTERVENTIONS						
IV antibiotics administered when needed	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
IV vasopressor administered	1 (50.0)	0 (0.0)	0 (0.0)	3 (33.3)	1 (50.0)	6 (66.7)
Diagnostic paracentesis performed	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Bedside minor surgical techniques for infectious source control	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)
TRAUMA INTERVENTIONS						
Cervical spine immobilisation performed after trauma	2 (100.0)	4 (44.4)	0 (0.0)	3 (33.3)	0 (0.0)	2 (22.2)
Three-way dressing performed for sucking chest wound	0 (0.0)	0 (0.0)	1 (50.0)	1 (11.1)	1 (50.0)	8 (88.9)
Fasciotomy or escharotomy performed for compartment syndrome	0 (0.0)	2 (22.2)	1 (50.0)	2 (22.2)	1 (50.0)	5 (55.6)
Opiate analgesia administered	0 (0.0)	8 (88.9)	2 (100.0)	0 (0.0)	0 (0.0)	1 (11.1)
Fractures immobilised	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Closed reduction of fracture or dislocation performed	0 (0.0)	6 (66.7)	2 (100.0)	3 (33.3)	0 (0.0)	0 (0.0)
Antibiotics administered for open fractures	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Initial wound care performance	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Tetanus vaccination or IVIg administered	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)	0 (0.0)	0 (0.0)

OBSTETRIC INTERVENTIONS						
Emergency vaginal delivery performed	1 (50.0)	4 (44.4)	1 (50.0)	4 (44.4)	0 (0.0)	1 (11.1)
Uterotonic drug administered	1 (50.0)	4 (44.4)	0 (0.0)	4 (44.4)	1 (50.0)	1 (11.1)
Neonatal resuscitation performed	0 (0.0)	3 (33.3)	1 (50.0)	4 (44.4)	1 (50.0)	2 (22.2)

EMERGENCY UNIT ASSESSMENT TOOL

DRAFT November 2018

For more information, contact: reynoldst@who.int

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Introduction

Emergency care addresses a wide-range of medical, surgical, and obstetric conditions, including injury, complications of pregnancy, exacerbations of non-communicable diseases (e.g. heart attacks, strokes), and acute infections (e.g. sepsis, malaria). Particularly in areas where barriers to care exist, emergency units are often the first point of contact with the healthcare system. Emergency care is a critical component of universal health care, and with sound planning and organization, has the potential to address conditions causing over half of deaths and a third of disability incurred annually in low- and middle-income countries.

A strategic assessment of emergency care capacity at healthcare facilities is among the first steps in the planning process. Findings can be used to identify gaps and target interventions at both individual facilities and across the healthcare system more broadly; in addition, periodic assessments may also be useful for monitoring capacity over time.

This assessment tool designed to evaluate the structure and key functions of an emergency unit (or any dedicated intake area for acutely ill and injured patients). It is derived from the WHO *Emergency Care System Framework*, WHO *Guidelines for Essential Trauma Care*, WHO *Tool for Situational Analysis to Assess Emergency and Essential Surgical Care* and the African Federation for Emergency Medicine *Emergency Care Assessment Tool*, and was informed by a broad review of other relevant instruments.

How to use this tool

This tool is designed to assess emergency care capacity and organization at the facility level. It can be used at an individual facility or across a group of facilities region- or country-wide. Hospital administrators and health system planners can use the findings to identify gaps in order to guide planning. If the tool is to be used at the regional or country level, either all facilities within a certain category should be assessed (all regional or district hospitals, for example), or a robust sampling strategy should be utilized to ensure that the facilities assessed best represent the regional or national reality. Sampling strategies for facility-based assessments include:

- Exhaustive sampling –all facilities in the target area (e.g., region, country) or of a specific type are assessed (eg. all district hospitals).
- Random sampling (including stratified and cluster random sampling) – facilities to be assessed are randomly selected from among a target group
- Purposeful sampling – facilities are chosen by well-informed stakeholders specifically to reflect the diversity of facilities, geography, administrative areas, patient volume, levels of care, etc.;

Exhaustive sampling of all relevant facilities is the most robust approach, but may not always be feasible. Considerations for choosing a sampling strategy include: objectives of the assessment, needs of stakeholders, total number and types of facilities, heterogeneity of the country or region (differences between urban and rural areas, for example), and need for statistical certainty. For more details on sampling strategies and sample size calculations for facility-based capacity assessments, see the WHO *Service Availability and Readiness Assessment* (SARA): http://www.who.int/healthinfo/systems/SARA_Implementation_Guide_Chapter2.pdf.

Prior to performing the assessment, permission should be sought and granted by the appropriate national agencies and facility administrators. The facility administration can also help identify key informants to participate in the assessment. Ideally, more than one key informant is approached to complete the tool to allow triangulation of responses, which may improve the accuracy of the results. If more than one key informant completes all or the respective part of the tool, there are multiple ways to compile the results: i) the median response for each question becomes the final response; or ii) the response of the key informant with the most understanding of a specific resource, service or function becomes the final response; or iii) a consensus-process is initiated (eg, a meeting convened) and a single answer for each question agreed upon by respondents.

Potential key informants that might provide important information for this assessment include:

- Facility administrators (e.g., medical director, human resources director, operations officer, nurse matron);
- Providers (e.g., nurses, clinical officers, specialists) who work in the emergency unit;
- Laboratory and radiology unit technicians;
- Technicians and biomedical engineers who interact with equipment in the aforementioned units/departments;
- Procurement and medical stores staff;
- Facility statistics and health information staff.

Note that not all facilities will have staff in all of these positions, or even have each of the units/departments above. In addition, the informant with the highest authority at the facility may not be the informant with the most accurate understanding of the availability of a given resource. For the section on signal functions, the key informant should someone with direct involvement in clinical care delivery.

It should also be noted that this tool does not define a minimum standard for every emergency unit at every level of the health system. It is intended as a general tool to identify gaps that can be addressed by implementation of standards promoted elsewhere. Ultimately, countries will need to determine which services they aim to provide at a given level of the health system.

Scoring system

There are four question types in this assessment:

1. Open-ended (e.g., name of facility);
2. Number response (e.g., number of emergency unit visits per year);
3. Discrete answers (e.g., yes or no);
4. Availability rating.

The availability rating questions are used to assess resource and service capacities, specifically the ability to perform key functions in the time frame needed for emergency care. These questions are meant to reflect the demand-side factors (e.g., number of patients in need) for the service, as well as the supply-side factors (e.g., sufficient resources, satisfactory training). For each of these questions, the resource or service should be noted as:

1 - Generally unavailable;
2 - Somewhat available (available to **ONLY SOME** of those who need it);
3 - Adequate (**PRESENT and AVAILABLE** to almost everyone in need, and used when needed).

If the availability rating is less than 3 (less than adequate), it is important to know the factors that contribute to its deficiency. Common factors that contribute to inadequate resources (such as supply chain problems, or lack of training) can then be identified and addressed. Therefore, for ratings less than 3, the person administering the survey should systematically prompt the key informant to identify reasons for the less than adequate rating; more than one factor can be marked per resource, service or function.

- *Infrastructure* - physical space, electricity, water
- *Absent equipment* – the resource is not present at the facility
- *Broken equipment* –the resource is present, but not in working order
- *Stock out* – the resource or function cannot be procured, or required supplies out of stock often due to stock management practices or procurement failures (e.g., reagents, tubes, IV catheters)
- *Training* – staff knowledge/skill gaps limit capacity to use the resource or perform a function

- *Personnel* - resource, service or function available, but lack of adequate numbers of staff limit capacity
- *User fees* - resource or function available, but out-of-pocket payment requirement prevents care delivery
- *Opening hours* - hours the facility can be accessed by acute patients
- *Other* – enter explanation in comments field

Signal Function Performance

Emergency care is a cross-cutting, service delivery innovation providing timely intervention for acute conditions such as sepsis or trauma. The capacity to perform key time-dependent interventions for these sentinel conditions can be used as a marker of overall emergency unit performance. Any limited availability of these key interventions signals a critical gap in emergency care delivery capacity. Use of these "signal functions" allows for a rapid, simple assessment and the identification of failures of emergency care delivery whose cause can then be identified and addressed. For example, identifying limited availability of intravenous volume resuscitation should prompt evaluation for causes such as lack of functioning equipment, supply stock-outs, gaps in staff skills/knowledge, or poor infrastructure.

Emergency Unit Assessment

1. Facility Characteristics

1.1 Identifying Information

1.1.1	**Date**	
1.1.2	**Country**	
1.1.3	**Name of facility**	
1.1.4	**Address of facility** (include city, state or province)	
1.1.5	**GPS Reading** (if available)	Degrees Minutes Seconds Latitude: Longitude:
1.1.6	**Name** person filing out form	
1.1.7	**Facility Contact(s)**	**1. Name:** **Phone:** **Email:** **2. Name:** **Phone:** **Email:**
1.1.8	**Level of facility***	□ Health centre or clinic(1) □ 1st level hospital(2) □ 2nd level hospital(3) □ Tertiary hospital(4)
1.1.9	**Type of facility**	□ Private hospital(1) □ NGO hospital(2) □ Government hospital(3)
1.1.10	Distance to nearest higher level facility:	
1.1.11	Is there an area (room, unit, department) specifically designated for emergency care? **Yes(1)** **No (2)**	
1.1.12	Population served by facility (e.g., 123,000):	
1.1.13	Interview Start Time (Use 24 hr clock system):	

*Footnote: see reference definitions

1.2 Facility Metrics

Descriptor		Number
1.2.1	Emergency unit visits per year	
1.2.2	Outpatient visits per year (excluding emergency unit visits)	
1.2.3	Inpatient admissions per year	
1.2.4	Beds/gurneys dedicated for general emergency care (not including inpatient beds)	
1.2.5	Inpatient hospital beds	
1.2.6	Functioning operating theatres (24/7)	
1.2.7	Functioning high acuity unit (e.g. ICU) beds with capacity for continuous monitoring and mechanical ventilation	
1.2.8	Emergency operations per year	
Available hours		
1.2.9	During which hours is the emergency unit covered by providers who are physically present in the unit?	
1.2.10	During which hours is the emergency unit covered by providers who are on call, inside the facility?	
1.2.11	During which hours is the emergency unit covered by providers who are on call outside the facility?	
	Opening hours of:	
1.2.12	Emergency Unit	
1.2.13	Laboratory	
1.2.14	Pharmacy	
1.2.15	Radiology	
1.2.16	Operating Theater	
1.2.17	**Comments:**	

1.3 Infrastructure and essential equipment

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate

	Infrastructure Element	Rating (1-3)	Comments (if rating <3)
1.3.1	Clean, running water		
1.3.2	Electricity source (e.g., wired, generator)		
1.3.3	Designated telephone or radio for communicating with other facilities and/or prehospital providers		
1.3.4	Paper-based emergency unit chart		
1.3.5	Electronic emergency unit chart		
1.3.6	Isolation room for infectious diseases (e.g., TB, haemorrhagic fever)		
1.3.7	Easy physical access to emergency unit for those requiring a wheelchair or stretcher		
1.3.8	Designated waiting area		
1.3.9	Designated triage area		
1.3.10	Designated resuscitation area		
1.3.11	Personal protective equipment (e.g., hair covers, eye protection, N95 face masks, impermeable gowns, shoe covers, gloves) in a range of sizes		
1.3.12	Electronic cardiac monitoring in emergency unit		
1.3.13	Crash trolley or code cart with high-acuity equipment and supplies of various sizes in emergency unit		
1.3.14	Rapid access to a transport ambulance and provider to administer care during transport for patients who need to be transferred to another facility		
1.3.15	Is there a dedicated mechanism (radio, telephone) for communication with other facilities for transfer of patients?		
1.3.16	Is there access to storage space within (or with immediate proximity to) the emergency unit, including secure storage for controlled substances?		
1.3.17	Access to dedicated staff work area (e.g. for paperwork, consultation calls)		
1.3.18	Access to toilet facilities for patients and staff		
1.3.19	Access to handwashing facilities in each patient care area		
1.3.20	System for stocking, managing, and dispensing medications in emergency unit		
1.3.21	Oxygen in emergency unit		

Which of the following methods supply oxygen in this unit?		Yes	No
1.3.22	Oxygen is supplied through a central piped system	1	2
1.3.23	Oxygen is supplied in tanks that are stored on this unit	1	2
1.3.24	Oxygen is supplied by oxygen concentrator stored on this unit	1	2
1.3.25	Emergency unit calls for tank of oxygen from central location if needed	1	2
1.3.26	Emergency unit calls for oxygen concentrator from central location if needed	1	2
1.3.27	**Comments:**		

1.4 Diagnostic Services

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)

[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	Descriptor	***Rating (1-3)***	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
Laboratory-based Testing											
1.4.1	Hemoglobin										
1.4.2	Full blood count										
1.4.3	Coagulation profile (PT/PTT)										
1.4.4	Electrolytes										
1.4.5	BUN and creatinine										
1.4.6	Lipase										
1.4.7	Cardiac marker (e.g., troponin)										
1.4.8	Arterial blood gas										
1.4.9	Cross matching for blood and blood products										
1.4.10	Blood cultures										
1.4.11	Capacity to obtain sterile blood samples for lab testing										
1.4.12	System for reporting lab results in a timely fashion										
Point of Care Testing – available in the emergency unit											
1.4.13	Urine dipstick										
1.4.14	Urine pregnancy										
1.4.15	Glucose										
1.4.16	Malaria Rapid Diagnostic Test (RDT)										
1.4.17	Rapid HIV testing										
Diagnostic imaging											
1.4.18	Stationary X-ray										
1.4.19	Portable X-ray for use in emergency unit										
1.4.20	Ultrasound in the hospital										
1.4.21	Ultrasound for use in emergency unit										
1.4.22	CT scan										
1.4.23	System for reporting radiology results in a timely fashion										
1.4.24	**Comments:**										

2. Human Resources

2.1 Emergency Care Clinical Providers

2.1.1	Do you have a core of fixed (non-rotating) providers permanently assigned to the emergency unit?	Yes (1)	No (2)

Descriptor		Total Number	Number of licensed or certified
Number of non-rotating providers assigned to emergency unit			
2.1.2	Nurses/nurse midwives		
2.1.3	Mid-level provider or advance practice nurses (e.g., clinical officers or nurse practitioners)		
2.1.4	Medical officers (doctors without specialist training)		
2.1.5	Emergency medicine specialists		
2.1.6	Other specialist doctor		
Number of rotating providers assigned to emergency unit			
2.1.7	Nurses/nurse midwives		
2.1.8	Mid-level provider or advance practice nurses (e.g., clinical officers or nurse practitioners)		
2.1.9	Medical officers (e.g., doctors without specialist training)		
2.1.10	Emergency medicine specialists		
2.1.11	Other specialist doctor		
2.1.12	**Comments:**		

2.2 Consulting Services Available to the Emergency Unit

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Always available

Consulting Service		Rating (1-3)	Comments
2.2.1	General Surgery		
2.2.2	OB/GYN		
2.2.3	Orthopedics		
2.2.4	Anesthesia		
2.2.5	Paediatrics		
2.2.6	Psychiatry		
2.2.7	Other (Please list):		

2.3 Ancillary Services available to the emergency unit

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Always available

Ancillary Service		Rating (1-3)	Comments
2.3.1	Social work services		
2.3.2	Patient transport services (personnel with wheelchairs and/or gurneys)		
2.3.3	Security personnel assigned to emergency service area		

3. Clinical Services

3.1 Access

3.1.1	What proportion of patients with emergency conditions are brought to the facility by ambulance with formally trained prehospital care providers?	_____ %	Don't know
3.1.2	Are there regulations and/or protocols mandating that acutely ill or injured patients are clinically triaged prior to being required to register?	Yes(1)	No(2)
3.1.3	Does the facility require payment prior to provision of initial emergency care?	Yes(1)	No(2)
3.1.4	Is there an electronic system for registration?	Yes(1)	No(2)
3.1.5	**Comments:**		

3.2 Triage

		Yes	No
3.2.1	Are vital signs measured in triage area?	1	2
3.2.2	Does this facility use a formal triage system (includes a structured triage tool, such as the WHO-ICRC integrated triage tool, used by trained personnel)? If no triage protocols, tick box and skip to 3.3 []	1	2
3.2.3	Are there time targets for each triage category (e.g., YELLOW – seen by provider within 2 hours)?	1	2
3.2.4	If there are time targets, is compliance tracked regularly?	1	2
3.2.5	Are there specific triage protocols for children <5 years of age?	1	2
3.2.6	Are there specific triage protocols for pregnant women?	1	2
3.2.7	**Comments:**		

3.3 Guidelines, protocols and checklists

Are the following written protocols available at this facility? [] No written protocols (if no written protocols in the unit, tick box above and go directly to section 3.4)		Yes	No
3.3.1	Protocol for systematic triage that ensures patients are seen in order of acuity	1	2
3.3.2	Syndromic surveillance guidelines with links to public health officials for case definition and reporting	1	2
3.3.3	Clear protocol for communication with hospital administration during times of overcrowding	1	2
3.3.4	Emergency unit specific emergency response protocol, including protocol for mass casualty incidents	1	2
Are the following clinical management protocols available at this facility?			
3.3.5	Protocol for initial approach to ABCDs (airway, breathing, circulation, basic neurologic function)	1	2
3.3.6	Trauma care checklist	1	2
3.3.7	Medical resuscitation checklist	1	2
3.3.8	Protocol for neonatal resuscitation	1	2
3.3.9	Protocol for volume resuscitation of children and adults	1	2
3.3.10	Protocol for adjusting interventions for malnourished patients	1	2
3.3.11	Protocol for post-exposure prevention of STI/HIV, emergency contraception, counseling	1	2
3.3.12	Protocol for management of labor and delivery in low risk women	1	2
Condition-specific management protocols for:			
3.3.13	Asthma exacerbation	1	2
3.3.14	Pneumonia	1	2
3.3.15	Maternal hemorrhage	1	2
3.3.16	Sepsis	1	2
3.3.17	Diabetic ketoacidosis	1	2
3.3.18	Other: _____	1	2
Are the following admission or discharge protocols available at this facility?			
3.3.19	Acuity-based internal transfer protocols to OR or ICU	1	2
3.3.20	Protocol for timely disposition from the emergency unit	1	2
3.3.21	Protocol for conveying information about discharge or disposition to the patient	1	2
3.3.22	Hand-over protocols when transferring patients from one care provider to another	1	2
Are the following outside transfer protocols available at this facility?			
3.3.23	Condition-specific transfer or referral protocols (e.g., criteria for transfer of burn patient to burn centre)	1	2
3.3.24	Communication with receiving facility prior to transfer of patients with emergency conditions	1	2

Are the following safety protocols available at this facility?		Yes	No
3.3.25	Infection prevention and control protocols	1	2
3.3.26	Protocol for post exposure prophylaxis for health care workers	1	2
3.3.27	Security protocols to protect staff, patients, and infrastructure from violence.	1	2
3.3.28	Protocol for managing hazardous exposures (including designated decontamination area)	1	2
3.3.29	Containment and disposal of sharps and biomedical waste	1	2
3.3.30	Plan to ensure emergency unit staff and patient safety if an incident occurs *within* the emergency unit (including space, transport, communications)	1	2
3.3.31	**Comments:**		

3.4 Quality improvement in the emergency unit

Are the following conducted in the emergency unit?		Yes	No
3.4.1	Systematic process for collecting patient data that links condition, management and outcomes (e.g., trauma registry)	1	2
3.4.2	Regular meetings convened to use clinical data for quality improvement (e.g., morbidity and mortality conferences, preventable death panels)	1	2
3.4.3	Tracking (e.g., clinical audit) to ensure that quality improvement actions (e.g., corrective action) are implemented after review meetings	1	2
3.4.4	Clinical document template (e.g., standardized clinical chart)	1	2
3.4.5	Has there been a visit to this emergency facility by a supervisor from outside the facility within the last 6 months?	1	2
3.4.6	Is there any documentation from the most recent external supervisory visit?	1	2
3.4.7	Does the document provide any feedback or comments on some aspect of emergency services?	1	2
3.4.8	**Comments:**		

4. Signal Function Performance

(The key informants for this section should be personnel with direct involvement in clinical care delivery)
Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	VITAL SIGNS, AIRWAY & BREATHING INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
Vital Signs											
4.1.1	Are vital signs measured in the triage area?										
4.1.2	Are vital signs measured in the Emergency Unit?										
Airway Interventions											
4.2.1	Use of manual maneuvers (e.g., jaw thrust, chin lift)										
4.2.2	Use of suction										
4.2.3	Placement of oro- or naso-pharyngeal airway device										
4.2.4	Placement of supraglottic device (e.g., LMA)										
4.2.5	Endotracheal intubation										
4.2.6	Creation of surgical airway										
Breathing Interventions											
4.3.1	Measurement of oxygen saturation at triage										
4.3.2	Measurement of oxygen saturation in emergency unit treatment area										
4.3.3	Administration of bronchodilator for reactive airway disease										
4.3.4	Administration of oxygen										
4.3.5	Bag-valve-mask ventilation										
4.3.6	Non-invasive mechanical ventilation (BiPAP, CPAP)										
4.3.7	Invasive mechanical ventilation										
4.3.8	Needle decompression of tension pneumothorax										
4.3.9	Placement of chest tube										
4.3.10	**Comments:**										

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	CIRCULATION INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in*
Volume Resuscitation											
4.4.1	Administration of oral rehydration										
4.4.2	Peripheral IV placement										
4.4.3	Intraosseous access										
4.4.4	Venous cutdown										
4.4.5	Central venous line placement										
4.4.6	IV fluid administration										
4.4.7	Adjustment of fluid resuscitation for malnutrition or severe anaemia										
4.4.8	Urinary catheter placement										
Control of Bleeding											
4.5.1	External control of haemorrhage										
4.5.2	Wound packing and/or suture placement to control bleeding										
4.5.3	Tourniquet placement										
4.5.4	Pelvic binding placement										
4.5.5	Safe transfusion (e.g., including screened blood, maintenance of sterility, monitoring)										
4.5.6	Point of care ultrasound (performance and interpretation)										
Cardiac Interventions											
4.6.1	Pericardiocentesis										
4.6.2	External defibrillation and/or cardioversion										
4.6.3	External cardiac pacing										
4.6.4	Adrenaline administration										
4.6.5	ECG with interpretation										
4.6.6	Aspirin administration for ischemia										
4.6.7	Thrombolytic administration for MI										
4.6.8	**Comments:**										

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

NEUROLOGIC INTERVENTIONS		***Rating*** (1-3)	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
Unconscious patient											
4.7.1	Point of care glucose testing										
4.7.2	Glucose administration for hypoglycemia										
4.7.3	Lumbar puncture										
Seizure											
4.7.5	Protection from secondary injury										
4.7.6	Benzodiazepine administration										
4.7.7	IV magnesium administration (for eclampsia)										
Other											
4.7.8	Mental status examination										
4.7.9	Extreme temperature management (hyper- or hypothermia)										
4.7.10	Safe physical restraint										
4.7.11	Medication administration for agitation										
4.7.12	Procedural sedation										
4.7.13	Relevant antidote administration for toxic exposure (eg, atropine, naloxone, anti-venin).										
	Comments:										

SEPSIS INTERVENTIONS		***Rating*** (1-3)	*Infrastructure*	*Absent*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
4.8.1	IV antibiotic administration										
4.8.2	IV vasopressor administration										
4.8.3	Diagnostic paracentesis										
4.8.4	Bedside minor surgical techniques for infectious source control (e.g., abscess)										
	Comments:										

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

TRAUMA INTERVENTIONS		Rating (1-3)	Infrastructure	Absent Equipment	Broken Equipment	Stock out	Training	Personnel	User fees	Opening hours	Other (specify in comments)
4.9.1	Cervical spine immobilization										
4.9.2	Three-way dressing for sucking chest wound										
4.9.3	Fasciotomy or escharotomy for compartment syndrome										
4.9.4	Opiate analgesia administration										
4.9.5	Fracture immobilization										
4.9.6	Closed reduction of fracture or dislocation										
4.9.7	Antibiotic administratino for open fracture										
4.9.8	Initial wound care										
4.9.9	Tetanus vaccination or IVIg as appropriate										
4.9.10	Rabies vaccination or IVIg as appropriate										
	Comments:										

OBSTETRIC INTERVENTIONS		Rating (1-3)	Infrastructure	Absent Equipment	Broken Equipment	Sockout (supplies)	Training	Personnel	User fees	Opening hours	Other (specify in comments)
4.10.1	Emergency vaginal delivery										
4.10.2	Uterotonic drug (e.g., oxytocin) administration										
4.10.3	Neonatal resuscitation										
	Comments:										

See also: WHO Essential Resources for Emergency Care: Equipment and Supplies

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	5-6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8
5-7Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
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	8
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	n/a
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	n/a
		(*d*) 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	8
		(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	8-10
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	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	8-13

		clear which confounders were adjusted for and why they were included	
		(*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	8-13
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	16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
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	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Emergency Unit Capacity in Northern Tanzania: A Cross-Sectional Survey

Authors:

*Malin Ardsby[1], *Frida Shayo[2], Francis Sakita (0000-0001-5879-6564)[2,4], Daniel Wilhelms (0000-0001-6347-3970)[1,5], Baraka Moshi[4], Parker Frankiewicz[7], Lincoln Luis Silva (0000-0001-8445-0743)[7], Catherine Staton (0000-0002-6468-2894)[6,7], Blandina Mmbaga (0000-0002-5550-1916)[2,3,4], Anjni P Joiner (0000-0002-8907-182X)[6,7]

*Joint first authors

Affiliations:

[1]Department of Emergency Medicine in Linköping, and Department of Biomedical and Clinical Sciences, Linköping University, SE-581 83, Linköping, Sweden

[2]Kilimanjaro Christian Medical Centre, PO Box 3010, Moshi, Tanzania

[3]Kilimanjaro Clinical Research Institute, Box 2236, Moshi, Tanzania

[4]Kilimanjaro Christian Medical University College, Box 2240, Moshi, Tanzania

[5]Division of Drug Research, Department of Medical and Health Sciences, Linköping University, SE-581 83, Linköping, Sweden

[6]Department of Emergency Medicine, Duke University School of Medicine, 2301 Erwin Road, Durham, NC, USA

[7]Center for Global Emergency Medicine Innovation and Implementation, Duke Global Health Institute, 2301 Erwin Road, Durham, NC, 27710 USA

Correspondence to:

Anjni Joiner

2301 Erwin Road, Duke Hospital North, Box 3096, Durham, NC 27710

anjni.joiner@duke.edu +1 919 687 4087

ABSTRACT

Introduction

Emergency medicine (EM) is a growing field in Sub-Saharan Africa. Characterising the current capacity of hospitals to provide emergency care is important in identifying gaps and future directions of growth. This study aimed to characterise the ability of emergency units (EU) to provide emergency care in the Kilimanjaro region in Northern Tanzania.

Methods

This was a cross-sectional study conducted at 11 hospitals with emergency care capacity in three districts in the Kilimanjaro region of Northern Tanzania assessed in May 2021. Hospital representatives were surveyed by two EM physicians using the Hospital Emergency Assessment tool developed by the World Health Organisation; data was analysed in Excel and STATA.

Results

All hospitals provided emergency services 24 hours a day. Nine had a designated area for emergency care, four had a core of fixed providers assigned to the EU, two lacked a protocol for systematic triage. For Airway and Breathing interventions, oxygen administration was adequate in ten hospitals, yet manual airway manoeuvres were only adequate in six and needle decompression in two. For Circulation interventions, fluid administration was adequate in all facilities, yet intraosseous access and external defibrillation were each only available in two. Only one facility had an ECG readily available in the EU and none were able to administer thrombolytic therapy. For trauma interventions, all facilities could immobilise fractures, yet lacked interventions such as cervical spinal immobilisation and pelvic binding. These deficiencies were primarily due to lack of training and resources.

Conclusion

Most facilities perform systematic triage of emergency patients, though major gaps were found in the diagnosis and treatment of acute coronary syndrome and initial stabilisation manoeuvres of trauma patients. Resource limitations were primarily due to equipment and training

deficiencies. We recommend the development of future interventions in all levels of facilities to improve the level of training.

Keywords: Emergency care capacity; Tanzania; sub-Saharan Africa; HEAT

Strengths and limitations of this study

- This study offers a broad overview of the ability of emergency units in Northern Tanzania to provide emergency care for acute conditions, a leading cause of morbidity and mortality in sub-Saharan Africa.
- An exhaustive sampling approach was used, where all hospitals within a three-district area were surveyed, allowing for a comprehensive evaluation.
- Access to statistical records was not possible in the majority of hospitals, therefore patient volumes were estimated in many facilities.
- This study was conducted in only one area of Tanzania, therefore results may not be generalizeable to other settings.

KEY MESSAGES

What is already known on this topic

Low- and middle-income countries, like Tanzania, bear a disproportionate burden of death and disability due to emergent conditions. Despite advances in emergency medicine training and capacity building in Tanzania, there are still significant gaps in emergency care.

What this study adds

This study assesses emergency units in 11 hospitals in the Kilimanjaro region to determine the current strengths and gaps in the provision of emergency care.

How this study might affect research, practice, or policy

By developing a better understanding of emergency care capacity in the Kilimanjaro region, the results of this study can be used to develop targeted interventions at both the facility and

regional levels to begin to bridge the existing gaps in emergency care and improve care coordination between hospitals.

BACKGROUND

Worldwide, up to 30 million deaths occur yearly due to emergencies and the majority of them occur in low- and middle-income countries (LMIC).[1–4] Historically, emergency care has been a neglected issue both at a health system level and in the global health discussion.[5–7] Recently the World Health Organisation and World Health Assembly have called for increased focus on improving emergency care through several recent initiatives.[5,6] Evaluating a system's capacity to provide emergency care in a given region is an important step to identifying gaps and improving care.

The Republic of Tanzania is a lower middle income country in Sub-Saharan Africa with a population of about 55,5 million inhabitants.[7] Like much of sub-Saharan Africa, there is a shortage of trained healthcare professionals, with an estimated 3 doctors and 39 nurses per 100 000 inhabitants in the country.[5] Emergency medicine is a growing field within the country, with increased focus on provision of emergency care, as evidenced by the country's first public emergency department, Muhimbili National Hospital in Dar es Salaam, which opened in 2010. As one of the country's four tertiary referral hospitals, it also houses the country's only emergency medicine residency program, which was created in academic cooperation with programs in South Africa, the United States and Canada.[5] At the moment emergency departments are developing at several hospitals and there is a small but growing number of emergency specialists in the country. In 2011, the Emergency Medicine Association of Tanzania (EMAT) was established and from the Ministry of Health has been given the trusteeship to support and develop emergency care in the country through research and education.[5]

Despite these advances, there are still significant gaps in emergency care. Previous studies assessing emergency surgical capacity and emergency care capacity across the country have identified gaps in infrastructure, human resources, and essential equipment.[4,8]

A need to identify existing gaps in emergency care provision is key in developing targeted interventions at the facility level. The African Federation for Emergency Medicine (AFEM) together with WHO, developed the Hospital Emergency Assessment tool (HEAT) to employ a standardised approach to assessing emergency care capacity in emergency units in low resource settings (supplementary file 1). The goal of this study was to perform a comprehensive

assessment of the emergency care capacity in the Kilimanjaro region by administering the Hospital Emergency Unit Assessment Tool (HEAT) to the eleven hospitals in the area.

METHODS

Setting

The Kilimanjaro region is located in the north of Tanzania and is the home of one the country's four tertiary referral hospitals, Kilimanjaro Christian Medical Centre (KCMC) located in the city of Moshi. The hospital serves a population of approximately 15 million people from surrounding urban and rural areas.[9] The country has six levels of healthcare facilities: Dispensaries, Health centres, District hospitals (First level facilities), Regional referral hospitals (Second level facilities) and Zonal referral hospitals (Tertiary level facilities) and the National hospital. Healthcare facilities are further categorised by funding source and include Government, Private and Non-governmental organisations (NGO) hospitals.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

Study Design

This was a cross-sectional study of eleven hospitals in the Kilimanjaro region of Northern Tanzania conducted in May 2021 (Table 1). We used an exhaustive sampling approach to select all first, second, and tertiary level hospitals as well as health centres from the following districts: Moshi Municipal Council, Moshi District Council and Hai District Council.

Table 1: List of hospitals in Moshi Municipal, Moshi District and Hai District Councils

Name of facility	Level of Facility	Type of Facility
Moshi Municipal Council		
Moshi Arusha	Health centre	Private hospital
Kilimanjaro First Hospital	First level hospital	NGO
St Joseph's hospital	First level hospital	Private hospital
Mawenzi Regional hospital	Second level hospital	Government hospital

Kilimanjaro Christian Medical Centre (KCMC)	Tertiary hospital	Private hospital
Moshi District Council		
TPC hospital	First level hospital	Government hospital
Kibosho hospital	First level hospital	Private hospital
Kilema hospital	First level hospital	Private hospital
Marangu hospital	First level hospital	Private hospital
Hai District Council		
Hai District hospital	First level hospital	Government hospital
Machame hospital	First level hospital	Private hospital

Hospitals in Moshi Municipal Council were on average 4.9 km (3.7 to 5.3 km) from the nearest higher level facility (Figure 1). Hospitals in Moshi District Council averaged 30.9 km (12.0 to 42.5 km) and 27.5km (25.0 to 30.0 km) for Hai District Council. In this context, we did not include the km to Muhimbili National Hospital in Dar es Salaam where occasionally patients from the tertiary hospital KCMC are referred for neurosurgical or specialised cardiac procedures.

Figure 1: Map of health facilities in Moshi Municipal, Moshi District, and Hai District Councils

When categorising facilities, we elected to use the terminology used in the HEAT tool (health centre, first level, second level, and tertiary level facilities) and further dichotomized facilities into lower level (health centres and first level) and higher level (second level and tertiary level) given the limited number of hospitals in each category.

Data Collection

Researchers contacted each facility in advance in order for the hospital to provide personnel for the day of the interview with knowledge of the clinical practice of the hospital and access to statistical data. Two researchers (MA and FS) performed the interviews, which were conducted in English. One of the researchers, fluent in Swahili and English, was able to translate when

needed. At each facility, between one to four hospital personnel were interviewed. Participants included administrators, senior nurses, and doctors. Additional inclusion criteria were: adult (aged 18 years or older), fluent in English, and employed at the current position for at least one year. Each participant provided verbal and written informed consent. The interviews lasted on average 2 hours and 15 minutes and data was collected using the web-based data collection tool REDCap.[10]

The HEAT Tool (Appendix 1), developed by the WHO in cooperation with the African Federation of Emergency Medicine (AFEM), was used to conduct the surveys. This tool has been used previously in several LMICs to evaluate emergency care provision in facilities.[11–14] It is divided into four sections: 1) Facility characteristics, 2) Human resources, 3) Clinical services and 4) Signal functions. Signal functions focus on assessing if a facility has the resources and skills needed to perform life-saving procedures for specific conditions, including airway, breathing, circulation, and neurologic emergencies as well as sepsis, trauma, and obstetric emergencies. Services and signal functions are rated on a 3-point scale as generally unavailable (1), some availability (2), and adequate (3).

Statistical analysis

The data were analysed using descriptive analysis using Excel (2016) and STATA (version 15). Categorical variables were summarised by use of frequency and percentage, while numerical variables were summarised by use of their respective measure of central tendency.

RESULTS

Facility characteristics

Most of the included hospitals (72.7%), including all of the hospitals located outside of Moshi Municipal Council (54.5%) were first level facilities (Table 2). Two of the first level facilities were run by the government as well as the only second level hospital included in the study. The rest of the hospitals were private with public partnership (63.6%) except one, which was run by an NGO. Full results may be reviewed in supplementary file 2.

Table 2. Description of health facilities in the Kilimanjaro region (N=11)

Variable	Frequency	Percentage
Level of facility*		
Lower level facility		
Health Centre	1	9.1
First level hospital	8	72.7
Higher level facility		
Second level hospital	1	9.1
Tertiary hospital	1	9.1
Type of facility		
Government hospital	3	27.3
NGO hospital	1	9.1
Private hospital	7	63.6
Designated room for emergency care		
Yes	9	81.8
No	2	18.2
Functioning high acuity unit (e.g. ICU) beds		
Absent	8	72.7
Present	3	27.3

Population of catchment area		
<200,000	1	9.1
200,000-250,000	4	36.4
>250,000	6	54.5
Number of emergency visit per year		
<200	3	27.3
200-700	3	27.3
≥700	5	45.5
Number of outpatients visit per year		
<20,000	3	27.3
20,000-70,000	7	63.6
>70,0000	1	9.1
Number of admissions per year		
<2,000	2	18.2
2,000- 7000	7	63.6
>7,000	2	18.2

All hospitals were able to provide emergency services 24 hours a day, seven days a week. All hospitals also reported 24/7 access to an operating theatre, and all had access to clean running water and adequate electricity.

All hospitals reported to have triage, however, only six (54.5%) had an adequate designated triage area. Nine of the hospitals had a designated area for emergency care, which ranged from a dedicated bed to an entire department. Only two hospitals had a separate emergency department, the tertiary level hospital and one first level hospital. These two hospitals reported an adequate resuscitation area. All others had some availability, for example a bed in the OPD or ward for resuscitation.

Only three hospitals (27.3%) reported to have a high acuity unit, with the number of dedicated beds ranging from 1 to 20. The majority of these were located in Moshi Municipal Council (84.0%). Only two hospitals had adequate isolation rooms for infectious diseases whereas two had none and the rest had some availability. Only one hospital in the region had a CT scanner available (Table 3).

Table 3. Equipment and diagnostic test availability in the facilities N(%)

	Adequate	Some Availability	Unavailable
Equipment			
Oxygen in the Emergency unit	8(72.7)	3(27.3)	0
Fully equipped crash trolley	2(18.2)	8(72.7) [a]	1(9.1)
Cardiac monitoring in the emergency unit	1(9.1)	5(45.5) [b]	5(45.5)
ECG in the emergency unit	1(9.1)	7(63.6) [c]	3(27.3)
Ultrasonography in the emergency unit	2(18.2)	8(72.7) [c]	1(9.1)
X-ray in the hospital	9(81.8)	0	2(18.2)
CT scan in the hospital	1(9.1)	0	10(90.9)
Diagnostic tests			
Arterial blood gas	0	2(18.2)	9(81.8)
Haemoglobin	0	10(90.9)	1(9.1)

Troponin	0	1(9.1) [d]	10(90.9)
Glucose	9(81.8)	2(18.2) [d]	0
Malaria rapid diagnostic testing	4(23.7)	8(72.7) [d]	0

Type of oxygen supply: Pipe 9.1%, concentrator 54.5%, oxygen tank 100%,
Possible to call for a tank when needed to the emergency unit 90.9%

[a]: Some availability means some drugs or equipment are lacking or the use of a cupboard instead of a trolley

[b] Some availability means somewhere else in the hospital like in a ward or some are broken and not enough

[c] Some availability means somewhere else in the hospital like in the radiology department

[d] Some availability means somewhere else in the hospital like in the laboratory, or sometimes out of stock

Human resources

Four of the facilities (36.4%), namely both the two higher level facilities and two of the first level hospitals reported to have a core of fixed non-rotating providers permanently assigned to the emergency unit (Appendix 2). The tertiary hospital had 32 nurses, 13 licensed medical officers and three emergency medical specialists. They also had a core of rotating interns. The secondary hospital had 19 nurses, 7 mid-level providers/advanced practice nurses and 11 medical officers of which 8 were licensed and no specialist. One of the first level facilities had 8 nurses, 4 mid-level providers/advanced practice nurses and one trauma specialist and the seconded of the first level facilities had 6 nurses and 6 licensed medical officers and no specialist.
All the other hospitals (63.6%) had rotating staff of nurses, mid-level providers and medical officers to the emergency unit; none of these hospitals had any rotating specialist.

Consulting services from anaesthesia were available in all hospitals except the health centre, though in all facilities except the tertiary hospital the consultant was a midlevel provider in anaesthesia as a result of the agreement on task shifting in the country due to shortage in doctors (15).

Clinical services

All hospitals except the health centre and one first level hospital acknowledged that there were regulations or protocols mandating that acutely ill or injured patients are clinically triaged prior to

registration (Appendix 3). All stated that vital signs are measured in the triage area. Six of the hospitals said they used a formal triage system (54.5%) but only two stated that time targets were tracked regularly (18.2%). Only one hospital reported specific triage protocols for children <5 years of age (9.1%) and no one reported specific triage protocols for pregnant women. Pregnant women and small children were systematically referred to the nearby maternity ward. All hospitals except two stated that they had a protocol for systemic triage that ensured patients to be seen in order of acuity (81.8%).

All hospitals except two reported to have protocols for initial approach to ABCDs (81.8%), only one had a trauma checklist (9.1%) and five had a medical resuscitation checklist (45.5%).

Signal functions

Figure 2: Signal function availability across higher and lower level facilities

Facilities were divided into higher level facilities, which included the tertiary hospital and the second level hospital, and lower level facilities, which included the health centre and all first level hospitals (Figure 2). For all signal functions, most services and treatments were typically reported as adequate or with some availability across both higher level and lower level facilities (Appendix 4). For Airway and Breathing interventions, all facilities generally noted a limited ability to place a supraglottic airway device, creation of a surgical airway, to use non-invasive and invasive mechanical ventilation, and to perform needle decompression for a tension pneumothorax.

Circulation interventions were reported as generally available in most facilities with the exception of intraosseous access, external defibrillation or cardioversion, and external cardiac pacing. No facility reported the ability to perform pericardiocentesis or administer thrombolytic therapy in the emergency unit. The ability to treat neurologic emergencies varied significantly by facility, however, all facilities indicated they were able to administer glucose for hypoglycemia and the majority could adequately perform mental status examinations. Management of extreme temperatures and protection of seizure patients from secondary injury seemed to vary the most among the facilities.

Most interventions for sepsis were reported to be able to be performed in all facilities, with the exception of IV vasopressor use. All facilities stated they could provide fracture immobilisation and initial wound care for trauma interventions. Most indicated the ability to administer IV antibiotics for open fractures, perform closed fracture or dislocation reductions, and administer a tetanus vaccine. The ability to place a three-way dressing for a sucking chest wound or perform a fasciotomy were typically reported as unavailable at most facilities. Obstetric interventions were also highly variable between facilities, with the most variability among those facilities able to perform neonatal resuscitation.

DISCUSSION

In this study, we achieved a comprehensive assessment of the emergency care capacity of all hospitals located in three districts in the Kilimanjaro region of northern Tanzania. With respect to facility characteristics, we found significant variation in dedicated space for emergency care treatment and assessment with only two hospitals having dedicated emergency departments, two hospitals with no facilities to care for emergency patients outside of the wards, and the remainder with access to a designated area for emergencies that was not classified as a separate department. Higher level facilities were located in the urban areas whereas the rural areas only had first level facilities. Like previous studies in other similar settings, we found that the higher level facilities were often better equipped.[4,12,14,16] For example, the only CT scanner in the study area was located in the tertiary hospital. With respect to human resources, only one hospital had emergency care specialists and seven hospitals had no access to rotating specialists, reflecting the overall dearth of specialists in the region. Most services and treatments for all signal functions were reported as adequate or with some availability across both higher level and lower level facilities. Similar to other emergency medicine capacity assessments in LMICs, we note that resource limitations with respect to equipment and training deficiencies were the primary drivers of gaps in adequate emergency care provision.[4,8,11–13,15-17]

In our study all facilities reported to have a triage area, and six had a separately designated space. This represents a significant change compared to a previous study in Tanzania from 2013, which demonstrated that only 30% of the facilities had a triage area.[4] Moreover, nine out

of the eleven hospitals stated that they had a protocol for systematic triage to ensure that patients were seen in order of acuity. Lack of adequate triage is common in LMICs and represents a significant challenge in addressing emergency conditions in hospitals.[11,13,18,19] Triage is a core function to provide timely care and triage systems in the emergency unit, in which a brief history and vital signs are obtained to sort patients to be seen in order of acuity, can improve care and reduce preventable deaths.[1,14] Our findings demonstrate a significant improvement in triage protocols compared to prior work in Tanzania, which found that only 13% of the hospitals that had triage guidelines for adults.[4] Whether this represents an overall change to the country or findings specific to this region is unclear.

We are experiencing an epidemiologic change in which the developing world has a growing number of noncommunicable diseases.[17,19,20] Cardiovascular diseases are underdiagnosed in sub-Saharan Africa and acute manifestations of these, such as myocardial infarction and cardiac arrest, result in a higher burden of deaths.[21,22] Reflective of this pattern, we noted significant gaps in the ability of hospitals to provide diagnostic and therapeutic cardiac interventions. Only one facility had access to an ECG in the emergency unit and three hospitals reported no ECG anywhere in the facility. Troponin was only available in one of the facilities, thrombolytic treatment for myocardial infarction was not available anywhere, and external defibrillation and pacing were also limited in availability. This lack of equipment and treatment availability for cardiovascular diseases has also been noted in other LMIC settings.[12,16,17,21,23] A qualitative interview study of physicians and clinical officers in Tanzania in 2017 indicated similar results regarding acute coronary syndrome (ACS) management in which lack of guidelines and poorly equipped facilities including both diagnostic equipment and treatment were highlighted.[23] Moreover, none of the facilities evaluated were able to provide percutaneous cardiac intervention (PCI) or rapid administration of fibrinolysis and the closest hospital providing these therapies was in Dar Es Salaam.

A previous assessment of the prevalence of acute myocardial infarction (AMI) in the emergency department at our tertiary hospital found an underrecognition of the diagnosis both for patients and for caregivers.[21] Up to 90% of the AMI cases were estimated to be under-diagnosed and a 30-day follow-up showed a more than 40% mortality in an AMI.[21] The lack of equipment, training, and treatments that we found indicate barriers to diagnosing and treating ACS, potentially contributing to the high mortality rate. Further focus on diagnostics could improve

underrecognition of ACS and improvement of low-cost interventions and appropriate referral may provide treatment benefits when more advanced treatments are unavailable.[21,24]

Another area for improvement was seen in initial trauma interventions. According to WHO guidelines essential trauma care includes the initial stabilisation of a trauma victim in order to prevent mortality and morbidity.[25] To this end, interventions such as cervical spine immobilisation, manual airway manoeuvres, and pelvic binder administration were limited in availability across much of the area due to lack of training and resources. Additionally, of all of the hospitals, only one had an available CT scanner. Knowing that a majority of deaths related to trauma occur in LMICs,[5,22,25] and that motor vehicle collisions are increasing in the Kilimanjaro area,[26,27] our findings identify important gaps in addressing emergency trauma care in the area. Several other studies measuring emergency care capacity in LMICs have identified suboptimal trauma management as well.[12,14,17,25] A prior study in Muhimbili National referral hospital found that most trauma patients transferred from both first and second level hospitals did not receive simple initial stabilisation manoeuvres such as cervical spine immobilisation or adequate splinting for extremity injuries.[25] These findings are reflective of our study. Simple training interventions and provision of basic equipment for trauma resuscitation in low resource settings have been shown to improve mortality and may have a role in this setting.[3,12]

The WHO has developed a Basic Emergency Care course (BEC) to improve emergency care in low-resource settings. A recent intervention in two district hospitals in Uganda aimed to improve emergency care provision through implementing the BEC course as well as introducing a triage protocol, two checklist protocols and a resuscitation area guidance. Through these interventions, they successfully reduced deaths due to emergencies by 50%.[28] Interventions like the BEC would likely improve the emergency care in this region significantly, particularly in facilities unable to provide basic emergency interventions.

On a larger scale, the limited availability of certain diagnostics highlights the need for strong referral networks for time-dependent emergencies, such as STEMI and trauma. Development of referral networks have been recommended to coordinate care centres and reduce the time to access life-saving treatment and have demonstrated improvements in mortality as well as timely access to care.[29–32] In settings such as in our study, where for example there is only one hospital with a CT scanner, it is imperative that appropriate referrals are made to higher level

facilities based on a predefined network.[24] A comprehensive approach should be taken when developing these systems of care, including development of unified clinical practice guidelines, education of clinicians, quality improvement, and registries.[24,31,33]

We note several limitations in this study. First, formal statistics at several of the hospitals were unavailable and many quantitative reports of facility characteristics were estimated by survey participants. There was generally no record keeping of specific emergency cases or emergency surgeries. Only the two hospitals with an emergency department maintained these records. Records of outpatient visits were kept in all facilities and emergency cases were included in these numbers if they were not admitted. If admitted, then they were included in admission records. Therefore, in these facilities, interviewees provided estimations of the numbers of emergency patients. We note that some variability in responses may be due to alternate interpretations of what constitutes an emergency patient. To address this limitation, we attempted to only interview those individuals with first-hand knowledge of the emergency unit to ensure the most accurate responses. Second, recall bias likely impacted the recollections of the interviewees with respect to multiple questions. The interviewees were mainly employees with significant knowledge of the hospital, such as a medical officer in charge. However, in some facilities, the available survey respondents were in alternate roles or less experienced, which may have biased the answers. When possible, we interviewed the most experienced personnel. Thirdly, all facilities referred all cases of obstetric or neonatal emergencies to the maternity ward, so these questions were overall challenging to answer for most of the participants. Most of the emergency surgeries were c-sections and these were excluded from the emergency surgery data collection. Finally, these results are specific to this region and may not be generalisable to other areas of Tanzania or to other countries in sub-Saharan Africa given facility-specific differences in personnel, training, infrastructure, and treatment protocols. However, our exhaustive sampling approach provided representation from all levels of hospitals in the region, therefore strengthening the study.

CONCLUSION

In this comprehensive assessment of eleven hospitals in northern Tanzania we found the reported overall capacity of the region to adequately respond to many emergency conditions, although significant variability existed between facilities. Specific to facility characteristics, all hospitals had the ability to triage patients and were open 24 hours a day and seven days per

week. However, dedicated space for emergency conditions was highly variable, ranging from no dedicated space, to a hospital bed, to a fully dedicated emergency unit. The major shortfalls were found in diagnosing and treatment of acute coronary syndrome and initial stabilisation manoeuvres in trauma patients. The majority of deficits across the region were related to shortages in equipment, specialised personnel, and need for additional training, similar to other studies in sub-Saharan Africa and LMICs. However, we see a marked improvement in clinical services, such as facility capacity to triage emergency patients, compared to a previous in-country assessment performed eight years ago, indicating increased focus and overall progress in the timely recognition of emergency conditions.

We see a need for stakeholders to address these issues and recommend future interventions in all levels of facilities specifically focused on training interventions such as the WHO BEC course as well as a focus on cardiovascular disease-specific training such as ECG interpretation. Focusing additional resources and equipment for lower level facilities may provide the most impact as they typically are the first to encounter patients and often less equipped than higher level facilities. Finally, the development of referral systems of care for time-dependent emergencies as a future step may best utilise limited resources.

Contribution statement: MA and FS collected and analysed the data, drafted and revised the paper. They are both guarantors. APJ, FS, DW, CS and DW designed the study and revised the paper. APJ initiated the collaborative project and monitored data collection. She is also a guarantor. LLS, PF, and BM analysed the data and revised the paper.

Competing Interests: None declared.

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Data sharing statement: All data generated or analysed during this study are available from the Kilimanjaro Christian Medical Centre upon reasonable request from the corresponding author.

Ethics statements

Patient Consent for Publication

Not applicable.

Ethical approval was obtained from the Duke University Institutional Review Board (IRB) (Pro000106116), Kilimanjaro Christian Medical Centre IRB (#2486), National Institute for Medical Research (HQ/R.8a/Vol.IX, 3425), and regional and district level permission to recruit health facilities obtained from the relevant authority. All participants provided written and verbal informed consent for participation in the study.

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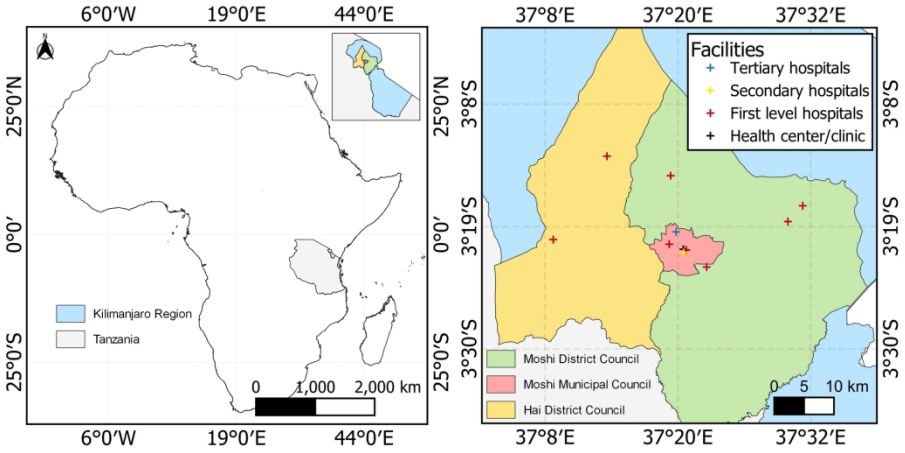

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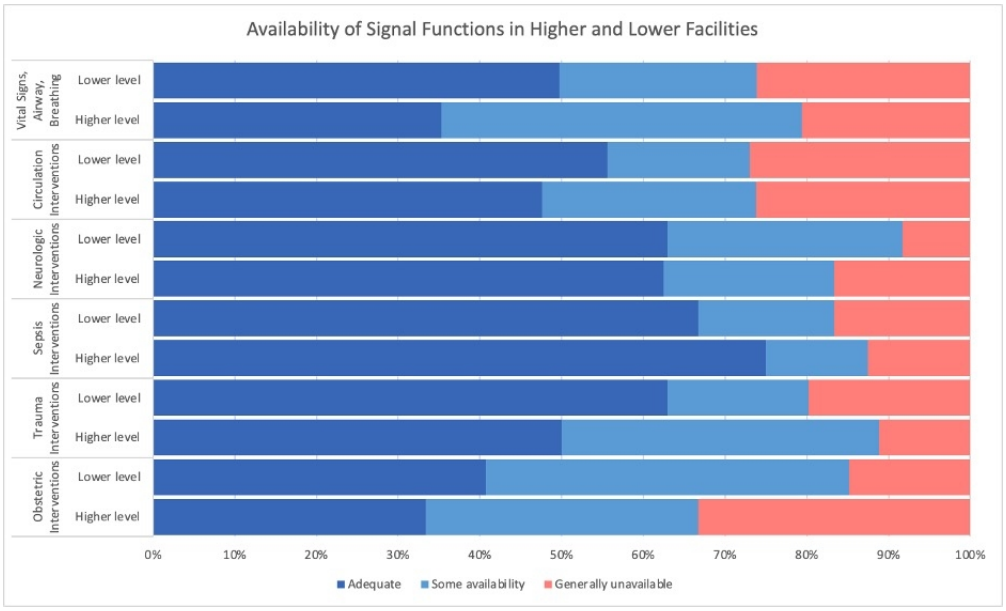

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EMERGENCY UNIT ASSESSMENT TOOL

DRAFT November 2018

For more information, contact: reynoldst@who.int

Table of Contents

Introduction

Emergency care addresses a wide-range of medical, surgical, and obstetric conditions, including injury, complications of pregnancy, exacerbations of non-communicable diseases (e.g. heart attacks, strokes), and acute infections (e.g. sepsis, malaria). Particularly in areas where barriers to care exist, emergency units are often the first point of contact with the healthcare system. Emergency care is a critical component of universal health care, and with sound planning and organization, has the potential to address conditions causing over half of deaths and a third of disability incurred annually in low- and middle-income countries.

A strategic assessment of emergency care capacity at healthcare facilities is among the first steps in the planning process. Findings can be used to identify gaps and target interventions at both individual facilities and across the healthcare system more broadly; in addition, periodic assessments may also be useful for monitoring capacity over time.

This assessment tool designed to evaluate the structure and key functions of an emergency unit (or any dedicated intake area for acutely ill and injured patients). It is derived from the WHO *Emergency Care System Framework*, WHO *Guidelines for Essential Trauma Care*, WHO *Tool for Situational Analysis to Assess Emergency and Essential Surgical Care* and the African Federation for Emergency Medicine *Emergency Care Assessment Tool*, and was informed by a broad review of other relevant instruments.

How to use this tool

This tool is designed to assess emergency care capacity and organization at the facility level. It can be used at an individual facility or across a group of facilities region- or country-wide. Hospital administrators and health system planners can use the findings to identify gaps in order to guide planning. If the tool is to be used at the regional or country level, either all facilities within a certain category should be assessed (all regional or district hospitals, for example), or a robust sampling strategy should be utilized to ensure that the facilities assessed best represent the regional or national reality. Sampling strategies for facility-based assessments include:

- Exhaustive sampling –all facilities in the target area (e.g., region, country) or of a specific type are assessed (eg. all district hospitals).
- Random sampling (including stratified and cluster random sampling) – facilities to be assessed are randomly selected from among a target group
- Purposeful sampling – facilities are chosen by well-informed stakeholders specifically to reflect the diversity of facilities, geography, administrative areas, patient volume, levels of care, etc.;

Exhaustive sampling of all relevant facilities is the most robust approach, but may not always be feasible. Considerations for choosing a sampling strategy include: objectives of the assessment, needs of stakeholders, total number and types of facilities, heterogeneity of the country or region (differences between urban and rural areas, for example), and need for statistical certainty. For more details on sampling strategies and sample size calculations for facility-based capacity assessments, see the WHO *Service Availability and Readiness Assessment* (SARA): http://www.who.int/healthinfo/systems/SARA_Implementation_Guide_Chapter2.pdf.

Prior to performing the assessment, permission should be sought and granted by the appropriate national agencies and facility administrators. The facility administration can also help identify key informants to participate in the assessment. Ideally, more than one key informant is approached to complete the tool to allow triangulation of responses, which may improve the accuracy of the results. If more than one key informant completes all or the respective part of the tool, there are multiple ways to compile the results: i) the median response for each question becomes the final response; or ii) the response of the key informant with the most understanding of a specific resource, service or function becomes the final response; or iii) a consensus-process is initiated (eg, a meeting convened) and a single answer for each question agreed upon by respondents.

Potential key informants that might provide important information for this assessment include:

- Facility administrators (e.g., medical director, human resources director, operations officer, nurse matron);
- Providers (e.g., nurses, clinical officers, specialists) who work in the emergency unit;
- Laboratory and radiology unit technicians;
- Technicians and biomedical engineers who interact with equipment in the aforementioned units/departments;
- Procurement and medical stores staff;
- Facility statistics and health information staff.

Note that not all facilities will have staff in all of these positions, or even have each of the units/departments above. In addition, the informant with the highest authority at the facility may not be the informant with the most accurate understanding of the availability of a given resource. For the section on signal functions, the key informant should someone with direct involvement in clinical care delivery.

It should also be noted that this tool does not define a minimum standard for every emergency unit at every level of the health system. It is intended as a general tool to identify gaps that can be addressed by implementation of standards promoted elsewhere. Ultimately, countries will need to determine which services they aim to provide at a given level of the health system.

Scoring system

There are four question types in this assessment:

1. Open-ended (e.g., name of facility);
2. Number response (e.g., number of emergency unit visits per year);
3. Discrete answers (e.g., yes or no);
4. Availability rating.

The availability rating questions are used to assess resource and service capacities, specifically the ability to perform key functions in the time frame needed for emergency care. These questions are meant to reflect the demand-side factors (e.g., number of patients in need) for the service, as well as the supply-side factors (e.g., sufficient resources, satisfactory training). For each of these questions, the resource or service should be noted as:

1 - Generally unavailable;
2 - Somewhat available (available to **ONLY SOME** of those who need it);
3 - Adequate (**PRESENT and AVAILABLE** to almost everyone in need, and used when needed).

If the availability rating is less than 3 (less than adequate), it is important to know the factors that contribute to its deficiency. Common factors that contribute to inadequate resources (such as supply chain problems, or lack of training) can then be identified and addressed. Therefore, for ratings less than 3, the person administering the survey should systematically prompt the key informant to identify reasons for the less than adequate rating; more than one factor can be marked per resource, service or function.

- *Infrastructure* - physical space, electricity, water
- *Absent equipment* – the resource is not present at the facility
- *Broken equipment* –the resource is present, but not in working order
- *Stock out* – the resource or function cannot be procured, or required supplies out of stock often due to stock management practices or procurement failures (e.g., reagents, tubes, IV catheters)
- *Training* – staff knowledge/skill gaps limit capacity to use the resource or perform a function

- *Personnel* - resource, service or function available, but lack of adequate numbers of staff limit capacity
- *User fees* - resource or function available, but out-of-pocket payment requirement prevents care delivery
- *Opening hours* - hours the facility can be accessed by acute patients
- *Other* – enter explanation in comments field

Signal Function Performance

Emergency care is a cross-cutting, service delivery innovation providing timely intervention for acute conditions such as sepsis or trauma. The capacity to perform key time-dependent interventions for these sentinel conditions can be used as a marker of overall emergency unit performance. Any limited availability of these key interventions signals a critical gap in emergency care delivery capacity. Use of these "signal functions" allows for a rapid, simple assessment and the identification of failures of emergency care delivery whose cause can then be identified and addressed. For example, identifying limited availability of intravenous volume resuscitation should prompt evaluation for causes such as lack of functioning equipment, supply stock-outs, gaps in staff skills/knowledge, or poor infrastructure.

Emergency Unit Assessment

1. Facility Characteristics

1.1 Identifying Information

1.1.1	**Date**	
1.1.2	**Country**	
1.1.3	**Name of facility**	
1.1.4	**Address of facility** (include city, state or province)	
1.1.5	**GPS Reading** (if available)	Degrees Minutes Seconds Latitude: Longitude:
1.1.6	**Name** person filing out form	
1.1.7	**Facility Contact(s)**	**1. Name:** **Phone:** **Email:** **2. Name:** **Phone:** **Email:**
1.1.8	**Level of facility***	□ Health centre or clinic(1) □ 1st level hospital(2) □ 2nd level hospital(3) □ Tertiary hospital(4)
1.1.9	**Type of facility**	□ Private hospital(1) □ NGO hospital(2) □ Government hospital(3)
1.1.10	Distance to nearest higher level facility:	
1.1.11	Is there an area (room, unit, department) specifically designated for emergency care? **Yes(1)** **No (2)**	
1.1.12	Population served by facility (e.g., 123,000):	
1.1.13	Interview Start Time (Use 24 hr clock system):	

*Footnote: see reference definitions

1.2 Facility Metrics

Descriptor		Number
1.2.1	Emergency unit visits per year	
1.2.2	Outpatient visits per year (excluding emergency unit visits)	
1.2.3	Inpatient admissions per year	
1.2.4	Beds/gurneys dedicated for general emergency care (not including inpatient beds)	
1.2.5	Inpatient hospital beds	
1.2.6	Functioning operating theatres (24/7)	
1.2.7	Functioning high acuity unit (e.g. ICU) beds with capacity for continuous monitoring and mechanical ventilation	
1.2.8	Emergency operations per year	
Available hours		
1.2.9	During which hours is the emergency unit covered by providers who are physically present in the unit?	
1.2.10	During which hours is the emergency unit covered by providers who are on call, inside the facility?	
1.2.11	During which hours is the emergency unit covered by providers who are on call outside the facility?	
	Opening hours of:	
1.2.12	Emergency Unit	
1.2.13	Laboratory	
1.2.14	Pharmacy	
1.2.15	Radiology	
1.2.16	Operating Theater	
1.2.17	**Comments:**	

1.3 Infrastructure and essential equipment

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate

Infrastructure Element		Rating (1-3)	Comments (if rating <3)
1.3.1	Clean, running water		
1.3.2	Electricity source (e.g., wired, generator)		
1.3.3	Designated telephone or radio for communicating with other facilities and/or prehospital providers		
1.3.4	Paper-based emergency unit chart		
1.3.5	Electronic emergency unit chart		
1.3.6	Isolation room for infectious diseases (e.g., TB, haemorrhagic fever)		
1.3.7	Easy physical access to emergency unit for those requiring a wheelchair or stretcher		
1.3.8	Designated waiting area		
1.3.9	Designated triage area		
1.3.10	Designated resuscitation area		
1.3.11	Personal protective equipment (e.g., hair covers, eye protection, N95 face masks, impermeable gowns, shoe covers, gloves) in a range of sizes		
1.3.12	Electronic cardiac monitoring in emergency unit		
1.3.13	Crash trolley or code cart with high-acuity equipment and supplies of various sizes in emergency unit		
1.3.14	Rapid access to a transport ambulance and provider to administer care during transport for patients who need to be transferred to another facility		
1.3.15	Is there a dedicated mechanism (radio, telephone) for communication with other facilities for transfer of patients?		
1.3.16	Is there access to storage space within (or with immediate proximity to) the emergency unit, including secure storage for controlled substances?		
1.3.17	Access to dedicated staff work area (e.g. for paperwork, consultation calls)		
1.3.18	Access to toilet facilities for patients and staff		
1.3.19	Access to handwashing facilities in each patient care area		
1.3.20	System for stocking, managing, and dispensing medications in emergency unit		
1.3.21	Oxygen in emergency unit		

Which of the following methods supply oxygen in this unit?		Yes	No
1.3.22	Oxygen is supplied through a central piped system	1	2
1.3.23	Oxygen is supplied in tanks that are stored on this unit	1	2
1.3.24	Oxygen is supplied by oxygen concentrator stored on this unit	1	2
1.3.25	Emergency unit calls for tank of oxygen from central location if needed	1	2
1.3.26	Emergency unit calls for oxygen concentrator from central location if needed	1	2
1.3.27	**Comments:**		

1.4 Diagnostic Services

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)

[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	Descriptor	Rating (1-3)	Infrastructure	Absent Equipment	Broken Equipment	Stock out (Supplies)	Training	Personnel	User fees	Opening hours	Other (specify in comments)
Laboratory-based Testing											
1.4.1	Hemoglobin										
1.4.2	Full blood count										
1.4.3	Coagulation profile (PT/PTT)										
1.4.4	Electrolytes										
1.4.5	BUN and creatinine										
1.4.6	Lipase										
1.4.7	Cardiac marker (e.g., troponin)										
1.4.8	Arterial blood gas										
1.4.9	Cross matching for blood and blood products										
1.4.10	Blood cultures										
1.4.11	Capacity to obtain sterile blood samples for lab testing										
1.4.12	System for reporting lab results in a timely fashion										
Point of Care Testing – available in the emergency unit											
1.4.13	Urine dipstick										
1.4.14	Urine pregnancy										
1.4.15	Glucose										
1.4.16	Malaria Rapid Diagnostic Test (RDT)										
1.4.17	Rapid HIV testing										
Diagnostic imaging											
1.4.18	Stationary X-ray										
1.4.19	Portable X-ray for use in emergency unit										
1.4.20	Ultrasound in the hospital										
1.4.21	Ultrasound for use in emergency unit										
1.4.22	CT scan										
1.4.23	System for reporting radiology results in a timely fashion										
1.4.24	**Comments:**										

2. Human Resources

2.1 Emergency Care Clinical Providers

2.1.1	Do you have a core of fixed (non-rotating) providers permanently assigned to the emergency unit?	Yes (1)	No (2)

Descriptor		Total Number	Number of licensed or certified
Number of non-rotating providers assigned to emergency unit			
2.1.2	Nurses/nurse midwives		
2.1.3	Mid-level provider or advance practice nurses (e.g., clinical officers or nurse practitioners)		
2.1.4	Medical officers (doctors without specialist training)		
2.1.5	Emergency medicine specialists		
2.1.6	Other specialist doctor		
Number of rotating providers assigned to emergency unit			
2.1.7	Nurses/nurse midwives		
2.1.8	Mid-level provider or advance practice nurses (e.g., clinical officers or nurse practitioners)		
2.1.9	Medical officers (e.g., doctors without specialist training)		
2.1.10	Emergency medicine specialists		
2.1.11	Other specialist doctor		
2.1.12	**Comments:**		

2.2 Consulting Services Available to the Emergency Unit

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Always available

Consulting Service		Rating (1-3)	Comments
2.2.1	General Surgery		
2.2.2	OB/GYN		
2.2.3	Orthopedics		
2.2.4	Anesthesia		
2.2.5	Paediatrics		
2.2.6	Psychiatry		
2.2.7	Other (Please list):		

2.3 Ancillary Services available to the emergency unit

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Always available

Ancillary Service		Rating (1-3)	Comments
2.3.1	Social work services		
2.3.2	Patient transport services (personnel with wheelchairs and/or gurneys)		
2.3.3	Security personnel assigned to emergency service area		

3. Clinical Services

3.1 Access

3.1.1	What proportion of patients with emergency conditions are brought to the facility by ambulance with formally trained prehospital care providers?	_____ %	Don't know
3.1.2	Are there regulations and/or protocols mandating that acutely ill or injured patients are clinically triaged prior to being required to register?	Yes(1)	No(2)
3.1.3	Does the facility require payment prior to provision of initial emergency care?	Yes(1)	No(2)
3.1.4	Is there an electronic system for registration?	Yes(1)	No(2)
3.1.5	**Comments:**		

3.2 Triage

		Yes	No
3.2.1	Are vital signs measured in triage area?	1	2
3.2.2	Does this facility use a formal triage system (includes a structured triage tool, such as the WHO-ICRC integrated triage tool, used by trained personnel)? If no triage protocols, tick box and skip to 3.3 []	1	2
3.2.3	Are there time targets for each triage category (e.g., YELLOW – seen by provider within 2 hours)?	1	2
3.2.4	If there are time targets, is compliance tracked regularly?	1	2
3.2.5	Are there specific triage protocols for children <5 years of age?	1	2
3.2.6	Are there specific triage protocols for pregnant women?	1	2
3.2.7	**Comments:**		

3.3 Guidelines, protocols and checklists

Are the following written protocols available at this facility? [] No written protocols (if no written protocols in the unit, tick box above and go directly to section 3.4)		Yes	No
3.3.1	Protocol for systematic triage that ensures patients are seen in order of acuity	1	2
3.3.2	Syndromic surveillance guidelines with links to public health officials for case definition and reporting	1	2
3.3.3	Clear protocol for communication with hospital administration during times of overcrowding	1	2
3.3.4	Emergency unit specific emergency response protocol, including protocol for mass casualty incidents	1	2
Are the following clinical management protocols available at this facility?			
3.3.5	Protocol for initial approach to ABCDs (airway, breathing, circulation, basic neurologic function)	1	2
3.3.6	Trauma care checklist	1	2
3.3.7	Medical resuscitation checklist	1	2
3.3.8	Protocol for neonatal resuscitation	1	2
3.3.9	Protocol for volume resuscitation of children and adults	1	2
3.3.10	Protocol for adjusting interventions for malnourished patients	1	2
3.3.11	Protocol for post-exposure prevention of STI/HIV, emergency contraception, counseling	1	2
3.3.12	Protocol for management of labor and delivery in low risk women	1	2
Condition-specific management protocols for:			
3.3.13	Asthma exacerbation	1	2
3.3.14	Pneumonia	1	2
3.3.15	Maternal hemorrhage	1	2
3.3.16	Sepsis	1	2
3.3.17	Diabetic ketoacidosis	1	2
3.3.18	Other: _____	1	2
Are the following admission or discharge protocols available at this facility?			
3.3.19	Acuity-based internal transfer protocols to OR or ICU	1	2
3.3.20	Protocol for timely disposition from the emergency unit	1	2
3.3.21	Protocol for conveying information about discharge or disposition to the patient	1	2
3.3.22	Hand-over protocols when transferring patients from one care provider to another	1	2
Are the following outside transfer protocols available at this facility?			
3.3.23	Condition-specific transfer or referral protocols (e.g., criteria for transfer of burn patient to burn centre)	1	2
3.3.24	Communication with receiving facility prior to transfer of patients with emergency conditions	1	2

Are the following safety protocols available at this facility?		Yes	No
3.3.25	Infection prevention and control protocols	1	2
3.3.26	Protocol for post exposure prophylaxis for health care workers	1	2
3.3.27	Security protocols to protect staff, patients, and infrastructure from violence.	1	2
3.3.28	Protocol for managing hazardous exposures (including designated decontamination area)	1	2
3.3.29	Containment and disposal of sharps and biomedical waste	1	2
3.3.30	Plan to ensure emergency unit staff and patient safety if an incident occurs *within* the emergency unit (including space, transport, communications)	1	2
3.3.31	**Comments:**		

3.4 Quality improvement in the emergency unit

Are the following conducted in the emergency unit?		Yes	No
3.4.1	Systematic process for collecting patient data that links condition, management and outcomes (e.g., trauma registry)	1	2
3.4.2	Regular meetings convened to use clinical data for quality improvement (e.g., morbidity and mortality conferences, preventable death panels)	1	2
3.4.3	Tracking (e.g., clinical audit) to ensure that quality improvement actions (e.g., corrective action) are implemented after review meetings	1	2
3.4.4	Clinical document template (e.g., standardized clinical chart)	1	2
3.4.5	Has there been a visit to this emergency facility by a supervisor from outside the facility within the last 6 months?	1	2
3.4.6	Is there any documentation from the most recent external supervisory visit?	1	2
3.4.7	Does the document provide any feedback or comments on some aspect of emergency services?	1	2
3.4.8	**Comments:**		

4. Signal Function Performance

(The key informants for this section should be personnel with direct involvement in clinical care delivery)
Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	VITAL SIGNS, AIRWAY & BREATHING INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
Vital Signs											
4.1.1	Are vital signs measured in the triage area?										
4.1.2	Are vital signs measured in the Emergency Unit?										
Airway Interventions											
4.2.1	Use of manual maneuvers (e.g., jaw thrust, chin lift)										
4.2.2	Use of suction										
4.2.3	Placement of oro- or naso-pharyngeal airway device										
4.2.4	Placement of supraglottic device (e.g., LMA)										
4.2.5	Endotracheal intubation										
4.2.6	Creation of surgical airway										
Breathing Interventions											
4.3.1	Measurement of oxygen saturation at triage										
4.3.2	Measurement of oxygen saturation in emergency unit treatment area										
4.3.3	Administration of bronchodilator for reactive airway disease										
4.3.4	Administration of oxygen										
4.3.5	Bag-valve-mask ventilation										
4.3.6	Non-invasive mechanical ventilation (BiPAP, CPAP)										
4.3.7	Invasive mechanical ventilation										
4.3.8	Needle decompression of tension pneumothorax										
4.3.9	Placement of chest tube										
4.3.10	**Comments:**										

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	CIRCULATION INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in*
Volume Resuscitation											
4.4.1	Administration of oral rehydration										
4.4.2	Peripheral IV placement										
4.4.3	Intraosseous access										
4.4.4	Venous cutdown										
4.4.5	Central venous line placement										
4.4.6	IV fluid administration										
4.4.7	Adjustment of fluid resuscitation for malnutrition or severe anaemia										
4.4.8	Urinary catheter placement										
Control of Bleeding											
4.5.1	External control of haemorrhage										
4.5.2	Wound packing and/or suture placement to control bleeding										
4.5.3	Tourniquet placement										
4.5.4	Pelvic binding placement										
4.5.5	Safe transfusion (e.g., including screened blood, maintenance of sterility, monitoring)										
4.5.6	Point of care ultrasound (performance and interpretation)										
Cardiac Interventions											
4.6.1	Pericardiocentesis										
4.6.2	External defibrillation and/or cardioversion										
4.6.3	External cardiac pacing										
4.6.4	Adrenaline administration										
4.6.5	ECG with interpretation										
4.6.6	Aspirin administration for ischemia										
4.6.7	Thrombolytic administration for MI										
4.6.8	**Comments:**										

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	NEUROLOGIC INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
Unconscious patient											
4.7.1	Point of care glucose testing										
4.7.2	Glucose administration for hypoglycemia										
4.7.3	Lumbar puncture										
Seizure											
4.7.5	Protection from secondary injury										
4.7.6	Benzodiazepine administration										
4.7.7	IV magnesium administration (for eclampsia)										
Other											
4.7.8	Mental status examination										
4.7.9	Extreme temperature management (hyper- or hypothermia)										
4.7.10	Safe physical restraint										
4.7.11	Medication administration for agitation										
4.7.12	Procedural sedation										
4.7.13	Relevant antidote administration for toxic exposure (eg, atropine, naloxone, anti-venin).										
	Comments:										

	SEPSIS INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
4.8.1	IV antibiotic administration										
4.8.2	IV vasopressor administration										
4.8.3	Diagnostic paracentesis										
4.8.4	Bedside minor surgical techniques for infectious source control (e.g., abscess)										
	Comments:										

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

TRAUMA INTERVENTIONS		Rating (1-3)	Infrastructure	Absent Equipment	Broken Equipment	Stock out	Training	Personnel	User fees	Opening hours	Other (specify in comments)
4.9.1	Cervical spine immobilization										
4.9.2	Three-way dressing for sucking chest wound										
4.9.3	Fasciotomy or escharotomy for compartment syndrome										
4.9.4	Opiate analgesia administration										
4.9.5	Fracture immobilization										
4.9.6	Closed reduction of fracture or dislocation										
4.9.7	Antibiotic administratino for open fracture										
4.9.8	Initial wound care										
4.9.9	Tetanus vaccination or IVIg as appropriate										
4.9.10	Rabies vaccination or IVIg as appropriate										
	Comments:										

OBSTETRIC INTERVENTIONS		Rating (1-3)	Infrastructure	Absent Equipment	Broken Equipment	Sockout (supplies)	Training	Personnel	User fees	Opening hours	Other (specify in comments)
4.10.1	Emergency vaginal delivery										
4.10.2	Uterotonic drug (e.g., oxytocin) administration										
4.10.3	Neonatal resuscitation										
	Comments:										

See also: WHO Essential Resources for Emergency Care: Equipment and Supplies

Supplemental material:

Full results

Human Resources Performances	**Yes, N (%)**		**No, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**
EMERGENCY CARE CLINICAL PROVIDERS				
Core of fixed providers permanently assigned to the emergency unit	2 (100.0)	2 (22.2)	0 (0.0)	7 (77.8)
	Average Number of Providers, N		**Average Number of Licensed or Certified Providers, N**	
	Higher level	**Lower level**	**Higher level**	**Lower level**
Number of <u>non-rotating</u> providers assigned to emergency unit				
Nurses/nurse midwives	25.5	1.6	18.0	1.6
Mid-level provider or advance practice nurses	3.5	0.4	3.5	0.4
Doctors without specialist training	12.0	0.8	10.5	0.8
Emergency medicine specialists	1.5	0.0	1.5	0.0
Other specialist doctor	0.0	0.1	0.0	0.1
Number of <u>rotating</u> providers assigned to emergency unit				

Nurses/nurse midwives	0.5	14.1	0.0	14.1
Mid-level provider or advance practice nurses	0.0	9.2	0.0	9.2
Doctors without specialist training	7.0	5.7	0	5.7
Emergency medicine specialists	0.0	0.0	0.0	0.0
Other specialist doctor	0.0	0.0	0.0	0.0

CONSULTING SERVICES AVAILABLE TO THE EMERGENCY UNIT						
	Adequate, N (%)		**Some Availability, N (%)**		**Generally unavailable, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**	**Higher level**	**Lower level**
Consulting Service						
General Surgery	2 (100.0)	4 (44.4)	0 (0.0)	3 (33.3)	0 (0.0)	2 (22.2)
OB/GYN	2 (100.0)	3 (33.3)	0 (0.0)	2 (22.2)	0 (0.0)	4 (44.4)
Orthopaedics	2 (100.0)	4 (44.4)	0 (0.0)	3 (33.3)	0 (0.0)	2 (22.2)
Anaesthesia	0 (0.0)	0 (0.0)	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Paediatrics	2 (100.0)	1 (11.1)	0 (0.0)	2 (22.2)	0 (0.0)	6 (66.7)
Psychiatry	1 (50.0)	2 (22.2)	1 (50.0)	2 (22.2)	0 (0.0)	5 (55.6)
Other Specialty	1 (50.0)	3 (33.3)	1 (50.0)	4 (44.4)	0 (0.0)	2 (22.2)

Clinical Services Performances	Average Proportion		Don't Know, N			
	Higher level	Lower level	Higher level		Lower level	
ACCESS						
Proportion of patients with emergency conditions brought to the facility by ambulance with formally trained prehospital care providers	0.325	0.065	N/A		1 facility	
	Yes, N (%)		No, N (%)		No Data, N (%)	
	Higher level	Lower level	Higher level	Lower level	Higher level	Lower level
Presence of regulations and/or protocols mandating that acutely ill or injured patients are clinically triaged prior to being required to register	2 (100.0)	7 (77.8)	0 (0.0)	1 (11.1)	0 (0.0)	1 (11.1)
Requirement of payment prior to provision of initial emergency care	0 (0.0)	2 (22.2)	2 (100.0)	7 (77.8)	0 (0.0)	0 (0.0)
Presence of an electronic system for registration	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
TRIAGE						
Vital signs measured in triage area	2 (100.0)	9 (100.0)	0 (0.0)	0 (10.0)	0 (0.0)	0 (0.0)
Formal triage system	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)	0 (0.0)	0 (0.0)

Time targets for each triage category	1 (50.0)	2 (22.2)	0 (0.0)	3 (33.3)	1 (50.0)	4 (44.4)
Regular tracking of compliance with time targets	0 (0.0)	2 (22.2)	0 (0.0)	1 (11.1)	2 (100.0)	6 (66.7)
Specific triage protocols for children <5 years of age	0 (0.0)	1 (11.1)	1 (50.0)	4 (44.4)	1 (50.0)	4 (44.4)
Specific triage protocols for pregnant women	0 (0.0)	0 (0.0)	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)
GUIDELINES, PROTOCOLS, AND CHECKLISTS						
	Yes, N (%)		**No, N (%)**			
	Higher level	**Lower level**	**Higher level**	**Lower level**		
Written protocols						
Presence of any written protocols.	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)		
	Yes		**No**			
	Higher level	**Lower level**	**Higher level**	**Lower level**		
Protocol for systematic triage that ensures patients are seen in order of acuity	2 (100.0)	7 (77.8)	0 (0.0)	2 (22.2)		
Syndromic surveillance guidelines with links to public health officials for case definition and reporting	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)		

Clear protocol for communication with hospital administration during times of overcrowding	0 (0.0)	4 (44.4)	2 (100.0)	5 (55.6)
Emergency-unit-specific emergency response protocol, including protocol for mass casualty incidents	1 (50.0)	4 (44.4)	1 (50.0)	5 (55.6)
Clinical management protocols				
Protocol for initial approach to ABCDs (airway, breathing, circulation, basic neurologic function)	2 (100.0)	7 (77.8)	0 (0.0)	2 (22.2)
Trauma care checklist	1 (50.0)	0 (0.0)	1 (50.0)	9 (100.0)
Medical resuscitation checklist	1 (50.0)	4 (44.4)	1 (50.0)	5 (55.6)
Protocol for neonatal resuscitation	0 (0.0)	6 (66.7)	2 (100.0)	3 (44.4)
Protocol for volume resuscitation of children and adults	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Protocol for adjusting interventions for malnourished patients	2 (100.0)	5 (55.6)	0 (0.0)	4 (44.4)
Protocol for post-exposure prevention of STI/HIV, emergency contraception, and counselling	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Protocol for management of labour and delivery in low risk women	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)
	Yes, N (%)		**No, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**

Condition-specific management protocols				
Asthma exacerbation	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Pneumonia	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Maternal haemorrhage	1 (50.0)	7 (77.8)	2 (50.0)	2 (22.2)
Sepsis	1 (50.0)	4 (44.4)	1 (50.0)	5 (55.6)
Diabetic ketoacidosis	2 (100.0)	5 (55.6)	0 (0.0)	4 (44.4)
Other condition	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Admission or discharge protocols				
Acuity-based internal transfer protocols to OR or ICU	1 (50.0)	3 (33.3)	1 (50.0)	6 (66.7)
Protocol for timely disposition from the emergency unit	2 (100.0)	4 (44.4)	0 (0.0)	5 (55.6)
Protocol for conveying information about discharge or disposition to the patient	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Hand-over protocols when transferring patients from one care provider to another	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Outside transfer protocols				
Condition-specific transfer or referral protocols	1 (50.0)	6 (66.7)	1 (50.0)	3 (33.3)

Communication with receiving facility prior to transfer of patients with emergency conditions	1 (50.0)	9 (100.0)	1 (50.0)	0 (0.0)
Safety protocols				
Infection prevention and control protocols	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
Protocol for post exposure prophylaxis for health care workers	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Security protocols to protect staff, patients, and infrastructure from violence.	0 (0.0)	6 (66.7)	2 (100.0)	3 (33.3)
Protocol for managing hazardous exposures (including designated decontamination area)	0 (0.0)	3 (33.3)	2 (100.0)	6 (66.7)
Containment and disposal of sharps and biomedical waste	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
Plan to ensure emergency unit staff and patient safety if an incident occurs within the emergency unit (including space, transport, communications)	0 (0.0)	4 (44.4)	2 (100.0)	5 (55.6)
QUALITY IMPROVEMENT IN THE EMERGENCY UNIT				
Systematic process for collecting patient data that links condition, management and outcomes (e.g., trauma registry)	2 (100.0)	4 (44.4)	0 (0.0)	5 (55.6)
Regular meetings convened to use clinical data for quality improvement (e.g., morbidity and mortality conferences, preventable death panels)	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)

Tracking (e.g., clinical audit) to ensure that quality improvement actions (e.g., corrective action) are implemented after review meetings	2 (100.0)	9 (100.0)	0 (0.0)		0 (0.0)	
Clinical document template (e.g., standardised clinical chart)	2 (100.0)	7 (77.8)	0 (0.0)		2 (22.2)	
Visit to this emergency facility by a supervisor from outside the facility within the last 6 months	2 (100.0)	8 (88.9)	0 (0.0)		1 (11.1)	
Documentation from the most recent external supervisory visit	2 (100.0)	8 (88.9)	0 (0.0)		1 (11.1)	
	Yes, N (%)		**No, N (%)**		**No Data, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**	**Higher level**	**Lower level**
Document provides feedback or comments on some aspect of emergency services	2 (100.0)	8 (88.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)

Signal Function Performances	**Adequate, N (%)**		**Some Availability, N (%)**		**Generally unavailable, N (%)**	
	Higher level	Lower level	Higher level	Lower level	Higher level	Lower level
VITAL SIGNS, AIRWAY, BREATHING						
Vital signs						
Vital signs triage area	1 (50.0)	9 (100.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)
Vital signs emergency unit	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)

Airway						
Manual airway manoeuvres	0 (0.0)	6 (66.7)	2 (100.0)	3 (33.3)	0 (0.0)	0 (0.0)
Use of suction	1 (50.0)	2 (22.2)	1 (50.0)	7 (77.8)	0 (0.0)	0 (0.0)
Placement of oro- or nasopharyngeal airway device	1 (50.0)	6 (66.7)	1 (50.0)	2 (22.2)	0 (0.0)	1 (11.1)
Placement of supraglottic device	0 (0.0)	1 (11.1)	0 (0.0)	4 (44.4)	2 (100.0)	4 (44.4)
Endotracheal intubation	2 (100.0)	3 (33.3)	0 (0.0)	4 (44.4)	0 (0.0)	2 (22.2)
Creation of surgical airway	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)	2 (100.0)	8 (88.9)
Breathing						
Saturation measured at triage	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)
Saturation measured in emergency unit	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Bronchodilator administered	1 (50.0)	4 (44.4)	1 (50.0)	3 (33.3)	0 (0.0)	2 (22.2)
Administration of oxygen	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Ventilation with BVM	1 (50.0)	8 (88.9)	1 (50.0)	0 (0.0)	0 (0.0)	1 (10.0)
Non-invasive mechanical ventilation	0 (0.0)	1 (11.1)	1 (50.0)	0 (0.0)	1 (50.0)	8 (88.9)
Invasive mechanical ventilation	0 (0.0)	0 (0.0)	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)
Needle decompression of tension ptx	0 (0.0)	2 (22.2)	1 (50.0)	1 (11.1)	1 (50.0)	6 (66.7)
Placement of chest tube	0 (0.0)	3 (33.3)	2 (100.0)	2 (22.2)	0 (0.0)	4 (44.4)
CIRCULATION INTERVENTIONS						
Volume Resuscitation						

Administration of oral rehydration	1 (50.0)	9 (100.0)	0 (0.0)	0 (0.0)	1 (50.0)	0 (0.0)
Peripheral IV placement	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Intraosseous access	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	9 (100.0)
Venous cutdown	0 (0.0)	5 (55.6)	1 (50.0)	2 (22.2)	1 (50.0)	2 (22.2)
Central venous line placement	0 (0.0)	2 (22.2)	1 (50.0)	6 (66.7)	1 (50.0)	1 (11.1)
IV fluid administration	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Adjustment of fluid resuscitation for malnutrition or severe anaemia	2 (100.0)	8 (88.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)
Urinary catheter placement	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Control of Bleeding						
External control of haemorrhage	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Wound packing and/or suture to control bleeding	2 (100.0)	7 (77.8)	0 (0.0)	2 (22.2)	0 (0.0)	0 (0.0)
Tourniquet placement	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Pelvic binding placement	0 (0.0)	2 (22.2)	2 (100.0)	3 (33.3)	0 (0.0)	4 (44.4)
Safe transfusion of blood performed	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Point of care ultrasound performed	0 (0.0)	1 (11.1)	1 (50.0)	6 (66.7)	1 (50.0)	2 (22.2)
Cardiac Interventions						
Pericardiocentesis performed	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	9 (100.0)
External defibrillation and/ or cardioversion performed	1 (50.0)	1 (11.1)	0 (0.0)	3 (33.3)	1 (50.0)	5 (55.6)

External cardiac pacing performed	0 (0.0)	0 (0.0)	1 (50.0)	2 (22.2)	1 (50.0)	7 (77.8)
Adrenaline available for administration	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
ECG performed and interpreted	0 (0.0)	4 (44.4)	1 (50.0)	3 (33.3)	1 (50.0)	2 (22.2)
Aspirin administered for ischemia	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Thrombolytic administration for MI	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	9 (100.0)
Unconscious Patient						
Point of care glucose testing for unconscious patients	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Glucose administered for hypoglycemia	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Lumbar puncture performed in unconscious patient	0 (0.0)	3 (33.3)	0 (0.0)	4 (44.4)	2 (100.0)	2 (22.2)
Seizure						
Protection from secondary injury of patient with seizure	1 (50.0)	3 (33.3)	0 (0.0)	4 (44.4)	1 (50.0)	2 (22.2)
Benzodiazepine administered for seizure	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
IV Magnesium admin for eclampsia	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Other						
Mental status examination performed	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Management of extreme temperature	1 (50.0)	2 (22.2)	0 (0.0)	3 (33.3)	1 (50.0)	4 (44.4)
Safe physical restraint performed when needed	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Medication administered for agitation	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)

Procedural sedation performed	1 (50.0)	2 (22.2)	1 (50.0)	6 (66.7)	0 (0.0)	1 (11.1)
Relevant antidote administered for toxic exposure	0 (0.0)	0 (0.0)	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
SEPSIS INTERVENTIONS						
IV antibiotics administered when needed	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
IV vasopressor administered	1 (50.0)	0 (0.0)	0 (0.0)	3 (33.3)	1 (50.0)	6 (66.7)
Diagnostic paracentesis performed	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Bedside minor surgical techniques for infectious source control	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)
TRAUMA INTERVENTIONS						
Cervical spine immobilisation performed after trauma	2 (100.0)	4 (44.4)	0 (0.0)	3 (33.3)	0 (0.0)	2 (22.2)
Three-way dressing performed for sucking chest wound	0 (0.0)	0 (0.0)	1 (50.0)	1 (11.1)	1 (50.0)	8 (88.9)
Fasciotomy or escharotomy performed for compartment syndrome	0 (0.0)	2 (22.2)	1 (50.0)	2 (22.2)	1 (50.0)	5 (55.6)
Opiate analgesia administered	0 (0.0)	8 (88.9)	2 (100.0)	0 (0.0)	0 (0.0)	1 (11.1)
Fractures immobilised	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Closed reduction of fracture or dislocation performed	0 (0.0)	6 (66.7)	2 (100.0)	3 (33.3)	0 (0.0)	0 (0.0)
Antibiotics administered for open fractures	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Initial wound care performance	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Tetanus vaccination or IVIg administered	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)	0 (0.0)	0 (0.0)

OBSTETRIC INTERVENTIONS						
Emergency vaginal delivery performed	1 (50.0)	4 (44.4)	1 (50.0)	4 (44.4)	0 (0.0)	1 (11.1)
Uterotonic drug administered	1 (50.0)	4 (44.4)	0 (0.0)	4 (44.4)	1 (50.0)	1 (11.1)
Neonatal resuscitation performed	0 (0.0)	3 (33.3)	1 (50.0)	4 (44.4)	1 (50.0)	2 (22.2)

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	5-6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8
5-7Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
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	8
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	n/a
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	n/a
		(*d*) 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	8
		(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	8-10
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	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	8-13

		clear which confounders were adjusted for and why they were included	
		(*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	8-13
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	16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
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	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Emergency unit capacity in Northern Tanzania: a cross-sectional survey

Authors:

*Malin Ardsby[1], *Frida Shayo[2], Francis Sakita (0000-0001-5879-6564)[2,4], Daniel Wilhelms (0000-0001-6347-3970)[1,5], Baraka Moshi[4], Parker Frankiewicz[7], Lincoln Luis Silva (0000-0001-8445-0743)[7], Catherine Staton (0000-0002-6468-2894)[6,7], Blandina Mmbaga (0000-0002-5550-1916)[2,3,4], Anjni P Joiner (0000-0002-8907-182X)[6,7]

*Joint first authors

Affiliations:

[1]Department of Emergency Medicine in Linköping, and Department of Biomedical and Clinical Sciences, Linköping University, SE-581 83, Linköping, Sweden

[2]Kilimanjaro Christian Medical Centre, PO Box 3010, Moshi, Tanzania

[3]Kilimanjaro Clinical Research Institute, Box 2236, Moshi, Tanzania

[4]Kilimanjaro Christian Medical University College, Box 2240, Moshi, Tanzania

[5]Division of Drug Research, Department of Medical and Health Sciences, Linköping University, SE-581 83, Linköping, Sweden

[6]Department of Emergency Medicine, Duke University School of Medicine, 2301 Erwin Road, Durham, NC, USA

[7]Center for Global Emergency Medicine Innovation and Implementation, Duke Global Health Institute, 2301 Erwin Road, Durham, NC, 27710, USA

Correspondence to:

Anjni Joiner

2301 Erwin Road, Duke Hospital North, Box 3096, Durham, NC 27710, USA

anjni.joiner@duke.edu +1 919 687 4087

ABSTRACT

Introduction

Emergency medicine (EM) is a growing field in Sub-Saharan Africa. Characterising the current capacity of hospitals to provide emergency care is important in identifying gaps and future directions of growth. This study aimed to characterise the ability of emergency units (EU) to provide emergency care in the Kilimanjaro region in Northern Tanzania.

Methods

This was a cross-sectional study conducted at 11 hospitals with emergency care capacity in three districts in the Kilimanjaro region of Northern Tanzania assessed in May 2021. An exhaustive sampling approach was used, whereby all hospitals within the three-district area were surveyed. Hospital representatives were surveyed by two EM physicians using the Hospital Emergency Assessment tool developed by the World Health Organisation; data was analysed in Excel and STATA.

Results

All hospitals provided emergency services 24 hours a day. Nine had a designated area for emergency care, four had a core of fixed providers assigned to the EU, two lacked a protocol for systematic triage. For Airway and Breathing interventions, oxygen administration was adequate in ten hospitals, yet manual airway manoeuvres were only adequate in six and needle decompression in two. For Circulation interventions, fluid administration was adequate in all facilities, yet intraosseous access and external defibrillation were each only available in two. Only one facility had an ECG readily available in the EU and none were able to administer thrombolytic therapy. For trauma interventions, all facilities could immobilise fractures, yet lacked interventions such as cervical spinal immobilisation and pelvic binding. These deficiencies were primarily due to lack of training and resources.

Conclusion

Most facilities perform systematic triage of emergency patients, though major gaps were found in the diagnosis and treatment of acute coronary syndrome and initial stabilisation manoeuvres of trauma patients. Resource limitations were primarily due to equipment and training

deficiencies. We recommend the development of future interventions in all levels of facilities to improve the level of training.

Keywords: Emergency care capacity; Tanzania; sub-Saharan Africa; HEAT

Strengths and limitations of this study

- This study offers a broad overview of the ability of emergency units in Northern Tanzania to provide emergency care for acute conditions, a leading cause of morbidity and mortality in sub-Saharan Africa.
- An exhaustive sampling approach was used, whereby all hospitals within a three-district area were surveyed, allowing for a comprehensive evaluation.
- Access to statistical records was not possible in the majority of hospitals; therefore, patient volumes were estimated in many facilities.
- This study was conducted in only one area of Tanzania, so the results may not be generalizable to other settings.

INTRODUCTION

Worldwide, up to 30 million deaths occur yearly due to emergencies and the majority of them occur in low- and middle-income countries (LMIC).[1–4] Historically, emergency care has been a neglected issue both at a health system level and in the global health discussion.[5–7] Recently the World Health Organisation and World Health Assembly have called for increased focus on improving emergency care through several recent initiatives.[5,6] Evaluating a system's capacity to provide emergency care in a given region is an important step to identifying gaps and improving care.

The Republic of Tanzania is a lower middle income country in Sub-Saharan Africa with a population of about 55,5 million inhabitants.[7] Like much of sub-Saharan Africa, there is a shortage of trained healthcare professionals, with an estimated 3 doctors and 39 nurses per 100 000 inhabitants in the country.[5] Emergency medicine is a growing field within the country, with increased focus on provision of emergency care, as evidenced by the country's first public emergency department, Muhimbili National Hospital in Dar es Salaam, which opened in 2010. As one of the country's four tertiary referral hospitals, it also houses the country's only emergency medicine residency program, which was created in academic cooperation with programs in South Africa, the United States and Canada.[5] At the moment emergency departments are developing at several hospitals and there is a small but growing number of emergency specialists in the country. In 2011, the Emergency Medicine Association of Tanzania (EMAT) was established and from the Ministry of Health has been given the trusteeship to support and develop emergency care in the country through research and education.[5]

Despite these advances, there are still significant gaps in emergency care. Previous studies assessing emergency surgical capacity and emergency care capacity across the country have identified gaps in infrastructure, human resources, and essential equipment.[4,8]

A need to identify existing gaps in emergency care provision is key in developing targeted interventions at the facility level. The African Federation for Emergency Medicine (AFEM) together with WHO, developed the Hospital Emergency Assessment tool (HEAT) to employ a standardised approach to assessing emergency care capacity in emergency units in low resource settings. The goal of this study was to perform a comprehensive assessment of the

emergency care capacity in the Kilimanjaro region by administering the Hospital Emergency Unit Assessment Tool (HEAT) to the eleven hospitals in the area.

METHODS

Setting

The Kilimanjaro region is located in the north of Tanzania and is the home of one the country's four tertiary referral hospitals, Kilimanjaro Christian Medical Centre (KCMC) located in the city of Moshi. The hospital serves a population of approximately 15 million people from surrounding urban and rural areas.[9] The country has six levels of healthcare facilities: Dispensaries, Health centres, District hospitals (first-level facilities), Regional referral hospitals (second-level facilities) and Zonal referral hospitals (tertiary-level facilities) and the National hospital. Healthcare facilities are further categorised by funding source and include Government, Private and Non-governmental organisations (NGO) hospitals.

Study design

This was a cross-sectional study of eleven hospitals in the Kilimanjaro region of Northern Tanzania conducted in May 2021 (Table 1). We used an exhaustive sampling approach to select all first-, second-, and tertiary-level hospitals as well as health centres from the following districts: Moshi Municipal Council, Moshi District Council and Hai District Council.

Table 1. List and description of hospitals in Moshi Municipal, Moshi District and Hai District Councils (N=11)

Facility Name	Facility level	Facility type	Designated room for emergency care	Functioning high acuity unit (e.g. ICU) beds	Population of catchment area	Emergency visits per year	Outpatient visits per year	Admissions per year
Moshi Municipal Council								
Moshi Arusha	Health centre	Private	Present	Absent	201,150*	10*	7,800	1,560
Kilimanjaro First hospital	First level	NGO	Absent	Absent	201,150*	256*	44,883	547
St. Joseph's hospital	First level	Private	Present	Present	225,225*	11,736	45,460	6,106

Mawenzi Regional hospital*	Second level	Government	Present	Absent	1,702,207	5,280	100,000	7,836
Kilimanjaro Christian Medical Centre (KCMC)	Tertiary hospital	Private	Present	Present	15,000,000	17,753	30,000	7,327
Moshi District Council								
TPC hospital	First level	Government	Absent	Absent	32,000*	643*	18,000	3,199
Kibosho hospital	First level	Private	Present	Present	273,507*	2,160*	48,730+	5,104
Kilema hospital	First level	Private	Present	Absent	300,000*	2,464*	18,058	3,230
Marangu hospital	First level	Private	Present	Absent	300,000*	161*	22,697	3,034
Hai District Council								
Hai District hospital	First level	Government	Present	Absent	336,000*	66*	57,862	3,099
Machame hospital	First level	Private	Present	Absent	245,458*	500*	26,419	4,074

**Indicates that the number was an approximation by hospital staff.*
+Kibosho hospital established an emergency department only one month prior to this survey, so this number is a projection.

Hospitals in Moshi Municipal Council were on average 4.9 km (3.7 to 5.3 km) from the nearest higher-level facility (Figure 1). Hospitals in Moshi District Council averaged 30.9 km (12.0 to 42.5 km) and 27.5km (25.0 to 30.0 km) for Hai District Council. In this context, we did not include the km to Muhimbili National Hospital in Dar es Salaam where occasionally patients from the tertiary hospital KCMC are referred for neurosurgical or specialised cardiac procedures.

When categorising facilities, we elected to use the terminology used in the HEAT tool (health centre, first-level, second-level, and tertiary-level facilities) and further dichotomized facilities into lower-level (health centres and first-level) and higher-level (second-level and tertiary-level) facilities, in view of the limited number of hospitals in each category.

Data collection

Researchers contacted each facility in advance in order for the hospital to provide personnel for the day of the interview with knowledge of the clinical practice of the hospital and access to

statistical data. Two researchers (MA and FS) performed the interviews, which were conducted in English. One of the researchers, fluent in Swahili and English, was able to translate when needed. At each facility, between one to four hospital personnel were interviewed. Participants included administrators, senior nurses, and doctors. Additional inclusion criteria were: adult (aged 18 years or older), fluent in English, and employed at the current position for at least one year. Each participant provided verbal and written informed consent. The interviews lasted on average 2 hours and 15 minutes and data was collected using the web-based data collection tool REDCap.[10]

The HEAT Tool (Supplementary file 1), developed by the WHO in cooperation with the African Federation of Emergency Medicine (AFEM), was used to conduct the surveys. This tool has been used previously in several LMICs to evaluate emergency care provision in facilities.[11–14] It is divided into four sections: 1) Facility characteristics, 2) Human resources, 3) Clinical services and 4) Signal functions. Signal functions focus on assessing if a facility has the resources and skills needed to perform life-saving procedures for specific conditions, including airway, breathing, circulation, and neurologic emergencies as well as sepsis, trauma, and obstetric emergencies. Services and signal functions are rated on a 3-point scale as generally unavailable (1), some availability (2), and adequate (3).

Statistical analysis

The data were analysed using descriptive analysis using Excel (2016) and STATA (version 15). Categorical variables were summarised by use of frequency and percentage, while numerical variables were summarised by use of their respective measure of central tendency.

Patient and public involvement

None.

RESULTS

Facility characteristics

Most of the included hospitals (72.7%), including all of the hospitals located outside of Moshi Municipal Council (54.5%) were first-level facilities (Table 1). Two of the first-level facilities were run by the government as well as the only second-level hospital included in the study. The rest

of the hospitals were private with public partnership (63.6%) except one, which was run by an NGO. Full results may be reviewed in supplementary file 2.

All hospitals were able to provide emergency services 24 hours a day, seven days a week. All hospitals also reported 24/7 access to an operating theatre, and all had access to clean running water and adequate electricity.

All hospitals reported to have triage, however, only six (54.5%) had an adequate designated triage area. Nine of the hospitals had a designated area for emergency care, which ranged from a dedicated bed to an entire department. Only two hospitals had a separate emergency department, the tertiary-level hospital and one first-level hospital. These two hospitals reported an adequate resuscitation area. All others had some availability, for example a bed in the OPD or ward for resuscitation.

Only three hospitals (27.3%) reported to have a high acuity unit, with the number of dedicated beds ranging from 1 to 20. The majority of these were located in Moshi Municipal Council (84.0%). Only two hospitals had adequate isolation rooms for infectious diseases whereas two had none and the rest had some availability. Only one hospital in the region had a CT scanner available (Table 2).

Table 2. Equipment and diagnostic test availability in the facilities N (%)

	Adequate	Some Availability	Unavailable
Equipment			
Oxygen in the Emergency unit	8 (72.7)	3 (27.3)	0
Fully equipped crash trolley	2 (18.2)	8 (72.7) [a]	1 (9.1)
Cardiac monitoring in the emergency unit	1 (9.1)	5 (45.5) [b]	5 (45.5)
ECG in the emergency unit	1 (9.1)	7 (63.6) [c]	3 (27.3)

Ultrasonography in the emergency unit	2 (18.2)	8 (72.7) [c]	1 (9.1)
X-ray in the hospital	9 (81.8)	0	2 (18.2)
CT scan in the hospital	1 (9.1)	0	10 (90.9)
Diagnostic tests			
Arterial blood gas	0	2 (18.2)	9 (81.8)
Haemoglobin	0	10 (90.9)	1 (9.1)
Troponin	0	1 (9.1) [d]	10 (90.9)
Glucose	9 (81.8)	2 (18.2) [d]	0
Malaria rapid diagnostic testing	4 (23.7)	8 (72.7) [d]	0

Type of oxygen supply: Pipe 9.1%, concentrator 54.5%, oxygen tank 100%,
Possible to call for a tank when needed to the emergency unit 90.9%

[a]: Some availability means some drugs or equipment are lacking or the use of a cupboard instead of a trolley

[b] Some availability means somewhere else in the hospital like in a ward or some are broken and not enough

[c] Some availability means somewhere else in the hospital like in the radiology department

[d] Some availability means somewhere else in the hospital like in the laboratory, or sometimes out of stock

Human resources

Four of the facilities (36.4%), namely both of the two higher-level facilities and two of the first-level hospitals reported to have a core of fixed non-rotating providers permanently assigned to the emergency unit (Supplementary file 2). The tertiary hospital had 32 nurses, 13 licensed medical officers and three emergency medical specialists. They also had a core of rotating interns. The secondary hospital had 19 nurses, 7 mid-level providers/advanced practice nurses and 11 medical officers of which 8 were licensed and no specialist. One of the first-level facilities had 8 nurses, 4 mid-level providers/advanced practice nurses and one trauma specialist and the seconded of the first-level facilities had 6 nurses and 6 licensed medical officers and no specialist.

All the other hospitals (63.6%) had rotating staff of nurses, mid-level providers and medical officers to the emergency unit; none of these hospitals had any rotating specialist.

Consulting services from anaesthesia were available in all hospitals except the health centre, though in all facilities except the tertiary hospital the consultant was a midlevel provider in anaesthesia as a result of the agreement on task shifting in the country due to shortage in doctors [15].

Clinical services

All hospitals except the health centre and one first-level hospital acknowledged that there were regulations or protocols mandating that acutely ill or injured patients are clinically triaged prior to registration (Supplementary file 2). All stated that vital signs are measured in the triage area. Six of the hospitals said they used a formal triage system (54.5%) but only two stated that time targets were tracked regularly (18.2%). Only one hospital reported specific triage protocols for children <5 years of age (9.1%) and no one reported specific triage protocols for pregnant women. Pregnant women and small children were systematically referred to the nearby maternity ward. All hospitals except two stated that they had a protocol for systemic triage that ensured patients to be seen in order of acuity (81.8%).

All hospitals except two reported to have protocols for initial approach to ABCDs (81.8%), only one had a trauma checklist (9.1%) and five had a medical resuscitation checklist (45.5%).

Signal functions

Facilities were divided into higher-level facilities, which included the tertiary hospital and the second-level hospital, and lower-level facilities, which included the health centre and all first-level hospitals (Figure 2). For all signal functions, most services and treatments were typically reported as adequate or with some availability across both higher-level and lower-level facilities (Supplementary file 2) For Airway and Breathing interventions, all facilities generally noted a limited ability to place a supraglottic airway device, creation of a surgical airway, to use non-invasive and invasive mechanical ventilation, and to perform needle decompression for a tension pneumothorax.

Circulation interventions were reported as generally available in most facilities with the exception of intraosseous access, external defibrillation or cardioversion, and external cardiac

pacing. No facility reported the ability to perform pericardiocentesis or administer thrombolytic therapy in the emergency unit. The ability to treat neurologic emergencies varied substantially by facility, however, all facilities indicated they were able to administer glucose for hypoglycemia and the majority could adequately perform mental status examinations. Management of extreme temperatures and protection of seizure patients from secondary injury seemed to vary the most among the facilities.

Most interventions for sepsis were reported to be able to be performed in all facilities, with the exception of IV vasopressor use. All facilities stated they could provide fracture immobilisation and initial wound care for trauma interventions. Most indicated the ability to administer IV antibiotics for open fractures, perform closed fracture or dislocation reductions, and administer a tetanus vaccine. The ability to place a three-way dressing for a sucking chest wound or perform a fasciotomy were typically reported as unavailable at most facilities. Obstetric interventions were also highly variable between facilities, with the most variability among those facilities able to perform neonatal resuscitation.

DISCUSSION

In this study, we achieved a comprehensive assessment of the emergency care capacity of all hospitals located in three districts in the Kilimanjaro region of northern Tanzania. With respect to facility characteristics, we found considerable variation in dedicated space for emergency care treatment and assessment with only two hospitals having dedicated emergency departments, two hospitals with no facilities to care for emergency patients outside of the wards, and the remainder with access to a designated area for emergencies that was not classified as a separate department. Higher-level facilities were located in the urban areas whereas the rural areas only had first-level facilities. Like previous studies in other similar settings, we found that the higher-level facilities were often better equipped.[4,12,14,16] For example, the only CT scanner in the study area was located in the tertiary hospital. With respect to human resources, only one hospital had emergency care specialists and seven hospitals had no access to rotating specialists, reflecting the overall dearth of specialists in the region. Most services and treatments for all signal functions were reported as adequate or with some availability across both higher-level and lower-level facilities. Similar to other emergency medicine capacity assessments in LMICs, we note that resource limitations with respect to equipment and training deficiencies were the primary drivers of gaps in adequate emergency care provision.[4,8,11–13,16,17]

In our study all facilities reported to have a triage area, and six had a separately designated space. This represents a notable change compared to a previous study in Tanzania from 2013, which demonstrated that only 30% of the facilities had a triage area.[4] Moreover, nine out of the eleven hospitals stated that they had a protocol for systematic triage to ensure that patients were seen in order of acuity. Lack of adequate triage is common in LMICs and represents an important challenge in addressing emergency conditions in hospitals.[11,13,18,19] Triage is a core function to provide timely care and triage systems in the emergency unit, in which a brief history and vital signs are obtained to sort patients to be seen in order of acuity, can improve care and reduce preventable deaths.[1,14] Our findings demonstrate an improvement in triage protocols compared to prior work in Tanzania, which found that only 13% of the hospitals that had triage guidelines for adults.[4] Whether this represents an overall change to the country or findings specific to this region is unclear.

We are experiencing an epidemiologic change in which the developing world has a growing number of noncommunicable diseases.[17,19,20] Cardiovascular diseases are underdiagnosed in sub-Saharan Africa and acute manifestations of these, such as myocardial infarction and cardiac arrest, result in a higher burden of deaths.[21,22] Reflective of this pattern, we noted major gaps in the ability of hospitals to provide diagnostic and therapeutic cardiac interventions. Only one facility had access to an ECG in the emergency unit and three hospitals reported no ECG anywhere in the facility. Troponin was only available in one of the facilities, thrombolytic treatment for myocardial infarction was not available anywhere, and external defibrillation and pacing were also limited in availability. This lack of equipment and treatment availability for cardiovascular diseases has also been noted in other LMIC settings.[12,16,17,21,23] A qualitative interview study of physicians and clinical officers in Tanzania in 2017 indicated similar results regarding acute coronary syndrome (ACS) management in which lack of guidelines and poorly equipped facilities including both diagnostic equipment and treatment were highlighted.[23] Moreover, none of the facilities evaluated were able to provide percutaneous cardiac intervention (PCI) or rapid administration of fibrinolysis and the closest hospital providing these therapies was in Dar Es Salaam.

A previous assessment of the prevalence of acute myocardial infarction (AMI) in the emergency department at our tertiary hospital found an under-recognition of the diagnosis both for patients

and for caregivers.[21] Up to 90% of the AMI cases were estimated to be under-diagnosed and a 30-day follow-up showed a more than 40% mortality in an AMI.[21] The lack of equipment, training, and treatments that we found indicate barriers to diagnosing and treating ACS, potentially contributing to the high mortality rate. Further focus on diagnostics could improve under-recognition of ACS and improvement of low-cost interventions and appropriate referral may provide treatment benefits when more advanced treatments are unavailable.[21,24]

Another area for improvement was seen in initial trauma interventions. According to WHO guidelines essential trauma care includes the initial stabilisation of a trauma victim in order to prevent mortality and morbidity.[25] To this end, interventions such as cervical spine immobilisation, manual airway manoeuvres, and pelvic binder administration were limited in availability across much of the area due to lack of training and resources. Additionally, of all of the hospitals, only one had an available CT scanner. Knowing that a majority of deaths related to trauma occur in LMICs,[5,22,25] and that motor vehicle collisions are increasing in the Kilimanjaro area,[26,27] our findings identify important gaps in addressing emergency trauma care in the area. Several other studies measuring emergency care capacity in LMICs have identified suboptimal trauma management as well.[12,14,17,25] A prior study in Muhimbili National referral hospital found that most trauma patients transferred from both first- and second-level hospitals did not receive simple initial stabilisation manoeuvres such as cervical spine immobilisation or adequate splinting for extremity injuries.[25] These findings are reflective of our study. Simple training interventions and provision of basic equipment for trauma resuscitation in low resource settings have been shown to improve mortality and may have a role in this setting.[3,12]

The WHO has developed a Basic Emergency Care course (BEC) to improve emergency care in low-resource settings. A recent intervention in two district hospitals in Uganda aimed to improve emergency care provision through implementing the BEC course as well as introducing a triage protocol, two checklist protocols and a resuscitation area guidance. Through these interventions, they successfully reduced deaths due to emergencies by 50%.[28] Interventions like the BEC would likely improve the emergency care in this region substantially, particularly in facilities unable to provide basic emergency interventions.

On a larger scale, the limited availability of certain diagnostics highlights the need for strong referral networks for time-dependent emergencies, such as STEMI and trauma. Development of

referral networks have been recommended to coordinate care centres and reduce the time to access life-saving treatment and have demonstrated improvements in mortality as well as timely access to care.[29–32] In settings such as in our study, where for example there is only one hospital with a CT scanner, it is imperative that appropriate referrals are made to higher-level facilities based on a predefined network.[24] A comprehensive approach should be taken when developing these systems of care, including development of unified clinical practice guidelines, education of clinicians, quality improvement, and registries.[24,31,33]

We note several limitations in this study. First, formal statistics at several of the hospitals were unavailable and many quantitative reports of facility characteristics were estimated by survey participants. There was generally no record keeping of specific emergency cases or emergency surgeries. Only the two hospitals with an emergency department maintained these records. Records of outpatient visits were kept in all facilities and emergency cases were included in these numbers if they were not admitted. If admitted, then they were included in admission records. Therefore, in these facilities, interviewees provided estimations of the numbers of emergency patients. We note that some variability in responses may be due to alternate interpretations of what constitutes an emergency patient. To address this limitation, we attempted to only interview those individuals with first-hand knowledge of the emergency unit to ensure the most accurate responses. Second, recall bias likely impacted the recollections of the interviewees with respect to multiple questions. The interviewees were mainly employees with significant knowledge of the hospital, such as a medical officer in charge. However, in some facilities, the available survey respondents were in alternate roles or less experienced, which may have biased the answers. When possible, we interviewed the most experienced personnel. Thirdly, all facilities referred all cases of obstetric or neonatal emergencies to the maternity ward, so these questions were overall challenging to answer for most of the participants. Most of the emergency surgeries were c-sections and these were excluded from the emergency surgery data collection. Finally, these results are specific to this region and may not be generalizable to other areas of Tanzania or to other countries in sub-Saharan Africa given facility-specific differences in personnel, training, infrastructure, and treatment protocols. However, our exhaustive sampling approach provided representation from all levels of hospitals in the region, therefore strengthening the study.

CONCLUSION

In this comprehensive assessment of eleven hospitals in northern Tanzania we found the reported overall capacity of the region to adequately respond to many emergency conditions, although considerable variability existed between facilities. Specific to facility characteristics, all hospitals had the ability to triage patients and were open 24 hours a day and seven days per week. However, dedicated space for emergency conditions was highly variable, ranging from no dedicated space, to a hospital bed, to a fully dedicated emergency unit. The major shortfalls were found in diagnosing and treatment of acute coronary syndrome and initial stabilisation manoeuvres in trauma patients. The majority of deficits across the region were related to shortages in equipment, specialised personnel, and need for additional training, similar to other studies in sub-Saharan Africa and LMICs. However, we see a marked improvement in clinical services, such as facility capacity to triage emergency patients, compared to a previous in-country assessment performed eight years ago, indicating increased focus and overall progress in the timely recognition of emergency conditions.

We see a need for stakeholders to address these issues and recommend future interventions in all levels of facilities specifically focused on training interventions such as the WHO BEC course as well as a focus on cardiovascular disease-specific training such as ECG interpretation. Focusing additional resources and equipment for lower-level facilities may provide the most impact as they typically are the first to encounter patients and often less equipped than higher-level facilities. Finally, the development of referral systems of care for time-dependent emergencies as a future step may best utilise limited resources.

*** ***

Contributors

MA and FS collected and analysed the data, drafted and revised the paper. They are both guarantors. APJ, FS, DW, CS and DW designed the study and revised the paper. APJ initiated the collaborative project and monitored data collection. She is also a guarantor. LLS, PF, and BM analysed the data and revised the paper.

Competing interests

None declared.

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Data availability statement

All data generated or analysed during this study are available from the Kilimanjaro Christian Medical Centre upon reasonable request from the corresponding author.

Patient consent for publication

Not applicable.

Ethics approval

Ethical approval was obtained from the Duke University Institutional Review Board (IRB) (Pro000106116), Kilimanjaro Christian Medical Centre IRB (#2486), National Institute for Medical Research (HQ/R.8a/Vol.IX, 3425), and regional- and district-level permission to recruit health facilities obtained from the relevant authority. All participants provided written and verbal informed consent for participation in the study.

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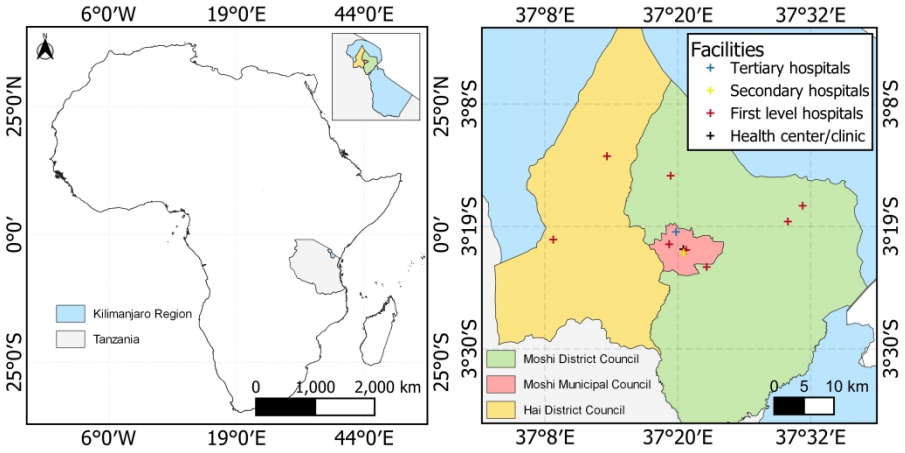
FIGURE TITLES

Figure 1. Map of health facilities in Moshi Municipal, Moshi District, and Hai District Councils

Figure 2. Signal function availability across higher-level and lower-level facilities



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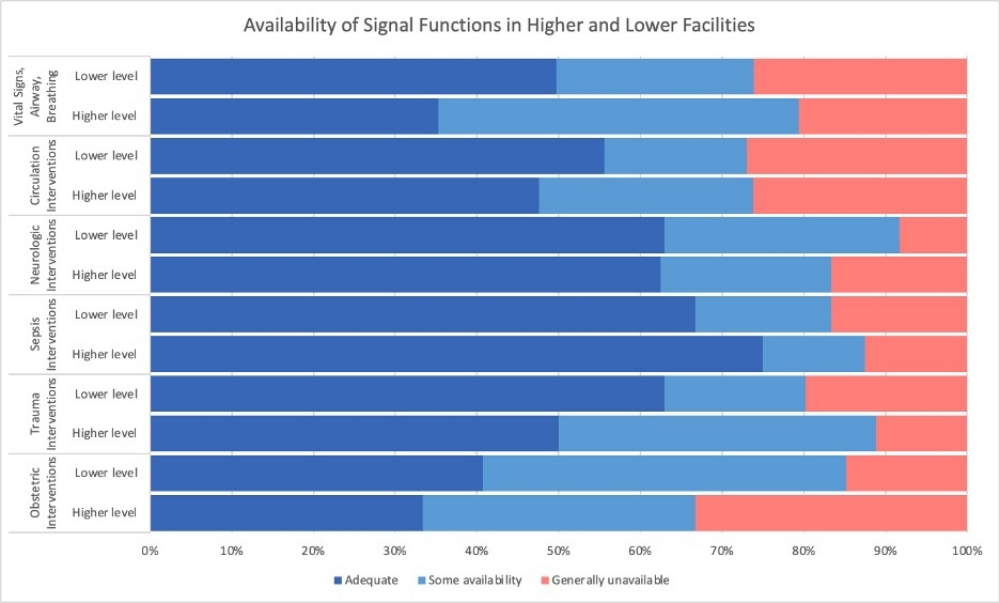

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EMERGENCY UNIT ASSESSMENT TOOL

DRAFT November 2018

For more information, contact: reynoldst@who.int

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Introduction

Emergency care addresses a wide-range of medical, surgical, and obstetric conditions, including injury, complications of pregnancy, exacerbations of non-communicable diseases (e.g. heart attacks, strokes), and acute infections (e.g. sepsis, malaria). Particularly in areas where barriers to care exist, emergency units are often the first point of contact with the healthcare system. Emergency care is a critical component of universal health care, and with sound planning and organization, has the potential to address conditions causing over half of deaths and a third of disability incurred annually in low- and middle-income countries.

A strategic assessment of emergency care capacity at healthcare facilities is among the first steps in the planning process. Findings can be used to identify gaps and target interventions at both individual facilities and across the healthcare system more broadly; in addition, periodic assessments may also be useful for monitoring capacity over time.

This assessment tool designed to evaluate the structure and key functions of an emergency unit (or any dedicated intake area for acutely ill and injured patients). It is derived from the WHO *Emergency Care System Framework*, WHO *Guidelines for Essential Trauma Care*, WHO *Tool for Situational Analysis to Assess Emergency and Essential Surgical Care* and the African Federation for Emergency Medicine *Emergency Care Assessment Tool*, and was informed by a broad review of other relevant instruments.

How to use this tool

This tool is designed to assess emergency care capacity and organization at the facility level. It can be used at an individual facility or across a group of facilities region- or country-wide. Hospital administrators and health system planners can use the findings to identify gaps in order to guide planning. If the tool is to be used at the regional or country level, either all facilities within a certain category should be assessed (all regional or district hospitals, for example), or a robust sampling strategy should be utilized to ensure that the facilities assessed best represent the regional or national reality. Sampling strategies for facility-based assessments include:

- Exhaustive sampling –all facilities in the target area (e.g., region, country) or of a specific type are assessed (eg. all district hospitals).
- Random sampling (including stratified and cluster random sampling) – facilities to be assessed are randomly selected from among a target group
- Purposeful sampling – facilities are chosen by well-informed stakeholders specifically to reflect the diversity of facilities, geography, administrative areas, patient volume, levels of care, etc.;

Exhaustive sampling of all relevant facilities is the most robust approach, but may not always be feasible. Considerations for choosing a sampling strategy include: objectives of the assessment, needs of stakeholders, total number and types of facilities, heterogeneity of the country or region (differences between urban and rural areas, for example), and need for statistical certainty. For more details on sampling strategies and sample size calculations for facility-based capacity assessments, see the WHO *Service Availability and Readiness Assessment* (SARA): http://www.who.int/healthinfo/systems/SARA_Implementation_Guide_Chapter2.pdf.

Prior to performing the assessment, permission should be sought and granted by the appropriate national agencies and facility administrators. The facility administration can also help identify key informants to participate in the assessment. Ideally, more than one key informant is approached to complete the tool to allow triangulation of responses, which may improve the accuracy of the results. If more than one key informant completes all or the respective part of the tool, there are multiple ways to compile the results: i) the median response for each question becomes the final response; or ii) the response of the key informant with the most understanding of a specific resource, service or function becomes the final response; or iii) a consensus-process is initiated (eg, a meeting convened) and a single answer for each question agreed upon by respondents.

Potential key informants that might provide important information for this assessment include:

- Facility administrators (e.g., medical director, human resources director, operations officer, nurse matron);
- Providers (e.g., nurses, clinical officers, specialists) who work in the emergency unit;
- Laboratory and radiology unit technicians;
- Technicians and biomedical engineers who interact with equipment in the aforementioned units/departments;
- Procurement and medical stores staff;
- Facility statistics and health information staff.

Note that not all facilities will have staff in all of these positions, or even have each of the units/departments above. In addition, the informant with the highest authority at the facility may not be the informant with the most accurate understanding of the availability of a given resource. For the section on signal functions, the key informant should someone with direct involvement in clinical care delivery.

It should also be noted that this tool does not define a minimum standard for every emergency unit at every level of the health system. It is intended as a general tool to identify gaps that can be addressed by implementation of standards promoted elsewhere. Ultimately, countries will need to determine which services they aim to provide at a given level of the health system.

Scoring system

There are four question types in this assessment:

1. Open-ended (e.g., name of facility);
2. Number response (e.g., number of emergency unit visits per year);
3. Discrete answers (e.g., yes or no);
4. Availability rating.

The availability rating questions are used to assess resource and service capacities, specifically the ability to perform key functions in the time frame needed for emergency care. These questions are meant to reflect the demand-side factors (e.g., number of patients in need) for the service, as well as the supply-side factors (e.g., sufficient resources, satisfactory training). For each of these questions, the resource or service should be noted as:

1 - Generally unavailable;
2 - Somewhat available (available to **ONLY SOME** of those who need it);
3 - Adequate (**PRESENT and AVAILABLE** to almost everyone in need, and used when needed).

If the availability rating is less than 3 (less than adequate), it is important to know the factors that contribute to its deficiency. Common factors that contribute to inadequate resources (such as supply chain problems, or lack of training) can then be identified and addressed. Therefore, for ratings less than 3, the person administering the survey should systematically prompt the key informant to identify reasons for the less than adequate rating; more than one factor can be marked per resource, service or function.

- *Infrastructure* - physical space, electricity, water
- *Absent equipment* – the resource is not present at the facility
- *Broken equipment* –the resource is present, but not in working order
- *Stock out* – the resource or function cannot be procured, or required supplies out of stock often due to stock management practices or procurement failures (e.g., reagents, tubes, IV catheters)
- *Training* – staff knowledge/skill gaps limit capacity to use the resource or perform a function

- *Personnel* - resource, service or function available, but lack of adequate numbers of staff limit capacity
- *User fees* - resource or function available, but out-of-pocket payment requirement prevents care delivery
- *Opening hours* - hours the facility can be accessed by acute patients
- *Other* – enter explanation in comments field

Signal Function Performance

Emergency care is a cross-cutting, service delivery innovation providing timely intervention for acute conditions such as sepsis or trauma. The capacity to perform key time-dependent interventions for these sentinel conditions can be used as a marker of overall emergency unit performance. Any limited availability of these key interventions signals a critical gap in emergency care delivery capacity. Use of these "signal functions" allows for a rapid, simple assessment and the identification of failures of emergency care delivery whose cause can then be identified and addressed. For example, identifying limited availability of intravenous volume resuscitation should prompt evaluation for causes such as lack of functioning equipment, supply stock-outs, gaps in staff skills/knowledge, or poor infrastructure.

Emergency Unit Assessment

1. Facility Characteristics

1.1 Identifying Information

1.1.1	**Date**	
1.1.2	**Country**	
1.1.3	**Name of facility**	
1.1.4	**Address of facility** (include city, state or province)	
1.1.5	**GPS Reading** (if available)	Degrees Minutes Seconds Latitude: Longitude:
1.1.6	**Name** person filing out form	
1.1.7	**Facility Contact(s)**	**1. Name:** **Phone:** **Email:** **2. Name:** **Phone:** **Email:**
1.1.8	**Level of facility***	□ Health centre or clinic(1) □ 1st level hospital(2) □ 2nd level hospital(3) □ Tertiary hospital(4)
1.1.9	**Type of facility**	□ Private hospital(1) □ NGO hospital(2) □ Government hospital(3)
1.1.10	Distance to nearest higher level facility:	
1.1.11	Is there an area (room, unit, department) specifically designated for emergency care? **Yes(1)** **No (2)**	
1.1.12	Population served by facility (e.g., 123,000):	
1.1.13	Interview Start Time (Use 24 hr clock system):	

*Footnote: see reference definitions

1.2 Facility Metrics

Descriptor		Number
1.2.1	Emergency unit visits per year	
1.2.2	Outpatient visits per year (excluding emergency unit visits)	
1.2.3	Inpatient admissions per year	
1.2.4	Beds/gurneys dedicated for general emergency care (not including inpatient beds)	
1.2.5	Inpatient hospital beds	
1.2.6	Functioning operating theatres (24/7)	
1.2.7	Functioning high acuity unit (e.g. ICU) beds with capacity for continuous monitoring and mechanical ventilation	
1.2.8	Emergency operations per year	
Available hours		
1.2.9	During which hours is the emergency unit covered by providers who are physically present in the unit?	
1.2.10	During which hours is the emergency unit covered by providers who are on call, inside the facility?	
1.2.11	During which hours is the emergency unit covered by providers who are on call outside the facility?	
	Opening hours of:	
1.2.12	Emergency Unit	
1.2.13	Laboratory	
1.2.14	Pharmacy	
1.2.15	Radiology	
1.2.16	Operating Theater	
1.2.17	**Comments:**	

1.3 Infrastructure and essential equipment

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate

	Infrastructure Element	**Rating** (1-3)	**Comments** (if rating <3)
1.3.1	Clean, running water		
1.3.2	Electricity source (e.g., wired, generator)		
1.3.3	Designated telephone or radio for communicating with other facilities and/or prehospital providers		
1.3.4	Paper-based emergency unit chart		
1.3.5	Electronic emergency unit chart		
1.3.6	Isolation room for infectious diseases (e.g., TB, haemorrhagic fever)		
1.3.7	Easy physical access to emergency unit for those requiring a wheelchair or stretcher		
1.3.8	Designated waiting area		
1.3.9	Designated triage area		
1.3.10	Designated resuscitation area		
1.3.11	Personal protective equipment (e.g., hair covers, eye protection, N95 face masks, impermeable gowns, shoe covers, gloves) in a range of sizes		
1.3.12	Electronic cardiac monitoring in emergency unit		
1.3.13	Crash trolley or code cart with high-acuity equipment and supplies of various sizes in emergency unit		
1.3.14	Rapid access to a transport ambulance and provider to administer care during transport for patients who need to be transferred to another facility		
1.3.15	Is there a dedicated mechanism (radio, telephone) for communication with other facilities for transfer of patients?		
1.3.16	Is there access to storage space within (or with immediate proximity to) the emergency unit, including secure storage for controlled substances?		
1.3.17	Access to dedicated staff work area (e.g. for paperwork, consultation calls)		
1.3.18	Access to toilet facilities for patients and staff		
1.3.19	Access to handwashing facilities in each patient care area		
1.3.20	System for stocking, managing, and dispensing medications in emergency unit		
1.3.21	Oxygen in emergency unit		

Which of the following methods supply oxygen in this unit?		Yes	No
1.3.22	Oxygen is supplied through a central piped system	1	2
1.3.23	Oxygen is supplied in tanks that are stored on this unit	1	2
1.3.24	Oxygen is supplied by oxygen concentrator stored on this unit	1	2
1.3.25	Emergency unit calls for tank of oxygen from central location if needed	1	2
1.3.26	Emergency unit calls for oxygen concentrator from central location if needed	1	2
1.3.27	**Comments:**		

1.4 Diagnostic Services

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)

[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	Descriptor	***Rating (1-3)***	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
Laboratory-based Testing											
1.4.1	Hemoglobin										
1.4.2	Full blood count										
1.4.3	Coagulation profile (PT/PTT)										
1.4.4	Electrolytes										
1.4.5	BUN and creatinine										
1.4.6	Lipase										
1.4.7	Cardiac marker (e.g., troponin)										
1.4.8	Arterial blood gas										
1.4.9	Cross matching for blood and blood products										
1.4.10	Blood cultures										
1.4.11	Capacity to obtain sterile blood samples for lab testing										
1.4.12	System for reporting lab results in a timely fashion										
Point of Care Testing – available in the emergency unit											
1.4.13	Urine dipstick										
1.4.14	Urine pregnancy										
1.4.15	Glucose										
1.4.16	Malaria Rapid Diagnostic Test (RDT)										
1.4.17	Rapid HIV testing										
Diagnostic imaging											
1.4.18	Stationary X-ray										
1.4.19	Portable X-ray for use in emergency unit										
1.4.20	Ultrasound in the hospital										
1.4.21	Ultrasound for use in emergency unit										
1.4.22	CT scan										
1.4.23	System for reporting radiology results in a timely fashion										
1.4.24	**Comments:**										

2. Human Resources

2.1 Emergency Care Clinical Providers

2.1.1	Do you have a core of fixed (non-rotating) providers permanently assigned to the emergency unit?	Yes (1)	No (2)

Descriptor		Total Number	Number of licensed or certified
Number of non-rotating providers assigned to emergency unit			
2.1.2	Nurses/nurse midwives		
2.1.3	Mid-level provider or advance practice nurses (e.g., clinical officers or nurse practitioners)		
2.1.4	Medical officers (doctors without specialist training)		
2.1.5	Emergency medicine specialists		
2.1.6	Other specialist doctor		
Number of rotating providers assigned to emergency unit			
2.1.7	Nurses/nurse midwives		
2.1.8	Mid-level provider or advance practice nurses (e.g., clinical officers or nurse practitioners)		
2.1.9	Medical officers (e.g., doctors without specialist training)		
2.1.10	Emergency medicine specialists		
2.1.11	Other specialist doctor		
2.1.12	**Comments:**		

2.2 Consulting Services Available to the Emergency Unit

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Always available

Consulting Service		Rating (1-3)	Comments
2.2.1	General Surgery		
2.2.2	OB/GYN		
2.2.3	Orthopedics		
2.2.4	Anesthesia		
2.2.5	Paediatrics		
2.2.6	Psychiatry		
2.2.7	Other (Please list):		

2.3 Ancillary Services available to the emergency unit

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Always available

Ancillary Service		Rating (1-3)	Comments
2.3.1	Social work services		
2.3.2	Patient transport services (personnel with wheelchairs and/or gurneys)		
2.3.3	Security personnel assigned to emergency service area		

3. Clinical Services

3.1 Access

3.1.1	What proportion of patients with emergency conditions are brought to the facility by ambulance with formally trained prehospital care providers?	_____ %	Don't know
3.1.2	Are there regulations and/or protocols mandating that acutely ill or injured patients are clinically triaged prior to being required to register?	Yes(1)	No(2)
3.1.3	Does the facility require payment prior to provision of initial emergency care?	Yes(1)	No(2)
3.1.4	Is there an electronic system for registration?	Yes(1)	No(2)
3.1.5	**Comments:**		

3.2 Triage

		Yes	No
3.2.1	Are vital signs measured in triage area?	1	2
3.2.2	Does this facility use a formal triage system (includes a structured triage tool, such as the WHO-ICRC integrated triage tool, used by trained personnel)? If no triage protocols, tick box and skip to 3.3 []	1	2
3.2.3	Are there time targets for each triage category (e.g., YELLOW – seen by provider within 2 hours)?	1	2
3.2.4	If there are time targets, is compliance tracked regularly?	1	2
3.2.5	Are there specific triage protocols for children <5 years of age?	1	2
3.2.6	Are there specific triage protocols for pregnant women?	1	2
3.2.7	**Comments:**		

3.3 Guidelines, protocols and checklists

Are the following written protocols available at this facility? [] No written protocols (if no written protocols in the unit, tick box above and go directly to section 3.4)		Yes	No
3.3.1	Protocol for systematic triage that ensures patients are seen in order of acuity	1	2
3.3.2	Syndromic surveillance guidelines with links to public health officials for case definition and reporting	1	2
3.3.3	Clear protocol for communication with hospital administration during times of overcrowding	1	2
3.3.4	Emergency unit specific emergency response protocol, including protocol for mass casualty incidents	1	2
Are the following clinical management protocols available at this facility?			
3.3.5	Protocol for initial approach to ABCDs (airway, breathing, circulation, basic neurologic function)	1	2
3.3.6	Trauma care checklist	1	2
3.3.7	Medical resuscitation checklist	1	2
3.3.8	Protocol for neonatal resuscitation	1	2
3.3.9	Protocol for volume resuscitation of children and adults	1	2
3.3.10	Protocol for adjusting interventions for malnourished patients	1	2
3.3.11	Protocol for post-exposure prevention of STI/HIV, emergency contraception, counseling	1	2
3.3.12	Protocol for management of labor and delivery in low risk women	1	2
Condition-specific management protocols for:			
3.3.13	Asthma exacerbation	1	2
3.3.14	Pneumonia	1	2
3.3.15	Maternal hemorrhage	1	2
3.3.16	Sepsis	1	2
3.3.17	Diabetic ketoacidosis	1	2
3.3.18	Other: _____	1	2
Are the following admission or discharge protocols available at this facility?			
3.3.19	Acuity-based internal transfer protocols to OR or ICU	1	2
3.3.20	Protocol for timely disposition from the emergency unit	1	2
3.3.21	Protocol for conveying information about discharge or disposition to the patient	1	2
3.3.22	Hand-over protocols when transferring patients from one care provider to another	1	2
Are the following outside transfer protocols available at this facility?			
3.3.23	Condition-specific transfer or referral protocols (e.g., criteria for transfer of burn patient to burn centre)	1	2
3.3.24	Communication with receiving facility prior to transfer of patients with emergency conditions	1	2

Are the following safety protocols available at this facility?		Yes	No
3.3.25	Infection prevention and control protocols	1	2
3.3.26	Protocol for post exposure prophylaxis for health care workers	1	2
3.3.27	Security protocols to protect staff, patients, and infrastructure from violence.	1	2
3.3.28	Protocol for managing hazardous exposures (including designated decontamination area)	1	2
3.3.29	Containment and disposal of sharps and biomedical waste	1	2
3.3.30	Plan to ensure emergency unit staff and patient safety if an incident occurs *within* the emergency unit (including space, transport, communications)	1	2
3.3.31	**Comments:**		

3.4 Quality improvement in the emergency unit

Are the following conducted in the emergency unit?		Yes	No
3.4.1	Systematic process for collecting patient data that links condition, management and outcomes (e.g., trauma registry)	1	2
3.4.2	Regular meetings convened to use clinical data for quality improvement (e.g., morbidity and mortality conferences, preventable death panels)	1	2
3.4.3	Tracking (e.g., clinical audit) to ensure that quality improvement actions (e.g., corrective action) are implemented after review meetings	1	2
3.4.4	Clinical document template (e.g., standardized clinical chart)	1	2
3.4.5	Has there been a visit to this emergency facility by a supervisor from outside the facility within the last 6 months?	1	2
3.4.6	Is there any documentation from the most recent external supervisory visit?	1	2
3.4.7	Does the document provide any feedback or comments on some aspect of emergency services?	1	2
3.4.8	**Comments:**		

4. Signal Function Performance

(The key informants for this section should be personnel with direct involvement in clinical care delivery)
Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	VITAL SIGNS, AIRWAY & BREATHING INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
Vital Signs											
4.1.1	Are vital signs measured in the triage area?										
4.1.2	Are vital signs measured in the Emergency Unit?										
Airway Interventions											
4.2.1	Use of manual maneuvers (e.g., jaw thrust, chin lift)										
4.2.2	Use of suction										
4.2.3	Placement of oro- or naso-pharyngeal airway device										
4.2.4	Placement of supraglottic device (e.g., LMA)										
4.2.5	Endotracheal intubation										
4.2.6	Creation of surgical airway										
Breathing Interventions											
4.3.1	Measurement of oxygen saturation at triage										
4.3.2	Measurement of oxygen saturation in emergency unit treatment area										
4.3.3	Administration of bronchodilator for reactive airway disease										
4.3.4	Administration of oxygen										
4.3.5	Bag-valve-mask ventilation										
4.3.6	Non-invasive mechanical ventilation (BiPAP, CPAP)										
4.3.7	Invasive mechanical ventilation										
4.3.8	Needle decompression of tension pneumothorax										
4.3.9	Placement of chest tube										
4.3.10	**Comments:**										

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	CIRCULATION INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in*
Volume Resuscitation											
4.4.1	Administration of oral rehydration										
4.4.2	Peripheral IV placement										
4.4.3	Intraosseous access										
4.4.4	Venous cutdown										
4.4.5	Central venous line placement										
4.4.6	IV fluid administration										
4.4.7	Adjustment of fluid resuscitation for malnutrition or severe anaemia										
4.4.8	Urinary catheter placement										
Control of Bleeding											
4.5.1	External control of haemorrhage										
4.5.2	Wound packing and/or suture placement to control bleeding										
4.5.3	Tourniquet placement										
4.5.4	Pelvic binding placement										
4.5.5	Safe transfusion (e.g., including screened blood, maintenance of sterility, monitoring)										
4.5.6	Point of care ultrasound (performance and interpretation)										
Cardiac Interventions											
4.6.1	Pericardiocentesis										
4.6.2	External defibrillation and/or cardioversion										
4.6.3	External cardiac pacing										
4.6.4	Adrenaline administration										
4.6.5	ECG with interpretation										
4.6.6	Aspirin administration for ischemia										
4.6.7	Thrombolytic administration for MI										
4.6.8	**Comments:**										

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

	NEUROLOGIC INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent Equipment*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
Unconscious patient											
4.7.1	Point of care glucose testing										
4.7.2	Glucose administration for hypoglycemia										
4.7.3	Lumbar puncture										
Seizure											
4.7.5	Protection from secondary injury										
4.7.6	Benzodiazepine administration										
4.7.7	IV magnesium administration (for eclampsia)										
Other											
4.7.8	Mental status examination										
4.7.9	Extreme temperature management (hyper- or hypothermia)										
4.7.10	Safe physical restraint										
4.7.11	Medication administration for agitation										
4.7.12	Procedural sedation										
4.7.13	Relevant antidote administration for toxic exposure (eg, atropine, naloxone, anti-venin).										
	Comments:										

	SEPSIS INTERVENTIONS	***Rating*** (1-3)	*Infrastructure*	*Absent*	*Broken Equipment*	*Stock out (Supplies)*	*Training*	*Personnel*	*User fees*	*Opening hours*	*Other (specify in comments)*
4.8.1	IV antibiotic administration										
4.8.2	IV vasopressor administration										
4.8.3	Diagnostic paracentesis										
4.8.4	Bedside minor surgical techniques for infectious source control (e.g., abscess)										
	Comments:										

Rating: 1 - Generally unavailable, 2 - Some availability, 3 – Adequate (For rating <3, mark all relevant barriers)
[For data entry: code any marked barriers as 1, unmarked barriers as 2]

TRAUMA INTERVENTIONS		Rating (1-3)	Infrastructure	Absent Equipment	Broken Equipment	Stock out	Training	Personnel	User fees	Opening hours	Other (specify in comments)
4.9.1	Cervical spine immobilization										
4.9.2	Three-way dressing for sucking chest wound										
4.9.3	Fasciotomy or escharotomy for compartment syndrome										
4.9.4	Opiate analgesia administration										
4.9.5	Fracture immobilization										
4.9.6	Closed reduction of fracture or dislocation										
4.9.7	Antibiotic administratino for open fracture										
4.9.8	Initial wound care										
4.9.9	Tetanus vaccination or IVIg as appropriate										
4.9.10	Rabies vaccination or IVIg as appropriate										
	Comments:										

OBSTETRIC INTERVENTIONS		Rating (1-3)	Infrastructure	Absent Equipment	Broken Equipment	Sockout (supplies)	Training	Personnel	User fees	Opening hours	Other (specify in comments)
4.10.1	Emergency vaginal delivery										
4.10.2	Uterotonic drug (e.g., oxytocin) administration										
4.10.3	Neonatal resuscitation										
	Comments:										

See also: WHO Essential Resources for Emergency Care: Equipment and Supplies

Supplemental material:

Full results

Human Resources Performances	**Yes, N (%)**		**No, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**
EMERGENCY CARE CLINICAL PROVIDERS				
Core of fixed providers permanently assigned to the emergency unit	2 (100.0)	2 (22.2)	0 (0.0)	7 (77.8)
	Average Number of Providers, N		**Average Number of Licensed or Certified Providers, N**	
	Higher level	**Lower level**	**Higher level**	**Lower level**
Number of <u>non-rotating</u> providers assigned to emergency unit				
Nurses/nurse midwives	25.5	1.6	18.0	1.6
Mid-level provider or advance practice nurses	3.5	0.4	3.5	0.4
Doctors without specialist training	12.0	0.8	10.5	0.8
Emergency medicine specialists	1.5	0.0	1.5	0.0
Other specialist doctor	0.0	0.1	0.0	0.1
Number of <u>rotating</u> providers assigned to emergency unit				

Nurses/nurse midwives	0.5	14.1	0.0	14.1
Mid-level provider or advance practice nurses	0.0	9.2	0.0	9.2
Doctors without specialist training	7.0	5.7	0	5.7
Emergency medicine specialists	0.0	0.0	0.0	0.0
Other specialist doctor	0.0	0.0	0.0	0.0

CONSULTING SERVICES AVAILABLE TO THE EMERGENCY UNIT						
	Adequate, N (%)		**Some Availability, N (%)**		**Generally unavailable, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**	**Higher level**	**Lower level**
Consulting Service						
General Surgery	2 (100.0)	4 (44.4)	0 (0.0)	3 (33.3)	0 (0.0)	2 (22.2)
OB/GYN	2 (100.0)	3 (33.3)	0 (0.0)	2 (22.2)	0 (0.0)	4 (44.4)
Orthopaedics	2 (100.0)	4 (44.4)	0 (0.0)	3 (33.3)	0 (0.0)	2 (22.2)
Anaesthesia	0 (0.0)	0 (0.0)	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Paediatrics	2 (100.0)	1 (11.1)	0 (0.0)	2 (22.2)	0 (0.0)	6 (66.7)
Psychiatry	1 (50.0)	2 (22.2)	1 (50.0)	2 (22.2)	0 (0.0)	5 (55.6)
Other Specialty	1 (50.0)	3 (33.3)	1 (50.0)	4 (44.4)	0 (0.0)	2 (22.2)

Clinical Services Performances	Average Proportion		Don't Know, N			
	Higher level	Lower level	Higher level		Lower level	
ACCESS						
Proportion of patients with emergency conditions brought to the facility by ambulance with formally trained prehospital care providers	0.325	0.065	N/A		1 facility	
	Yes, N (%)		No, N (%)		No Data, N (%)	
	Higher level	Lower level	Higher level	Lower level	Higher level	Lower level
Presence of regulations and/or protocols mandating that acutely ill or injured patients are clinically triaged prior to being required to register	2 (100.0)	7 (77.8)	0 (0.0)	1 (11.1)	0 (0.0)	1 (11.1)
Requirement of payment prior to provision of initial emergency care	0 (0.0)	2 (22.2)	2 (100.0)	7 (77.8)	0 (0.0)	0 (0.0)
Presence of an electronic system for registration	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
TRIAGE						
Vital signs measured in triage area	2 (100.0)	9 (100.0)	0 (0.0)	0 (10.0)	0 (0.0)	0 (0.0)
Formal triage system	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)	0 (0.0)	0 (0.0)

Time targets for each triage category	1 (50.0)	2 (22.2)	0 (0.0)	3 (33.3)	1 (50.0)	4 (44.4)
Regular tracking of compliance with time targets	0 (0.0)	2 (22.2)	0 (0.0)	1 (11.1)	2 (100.0)	6 (66.7)
Specific triage protocols for children <5 years of age	0 (0.0)	1 (11.1)	1 (50.0)	4 (44.4)	1 (50.0)	4 (44.4)
Specific triage protocols for pregnant women	0 (0.0)	0 (0.0)	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)
GUIDELINES, PROTOCOLS, AND CHECKLISTS						
	Yes, N (%)		**No, N (%)**			
	Higher level	**Lower level**	**Higher level**	**Lower level**		
Written protocols						
Presence of any written protocols.	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)		
	Yes		**No**			
	Higher level	**Lower level**	**Higher level**	**Lower level**		
Protocol for systematic triage that ensures patients are seen in order of acuity	2 (100.0)	7 (77.8)	0 (0.0)	2 (22.2)		
Syndromic surveillance guidelines with links to public health officials for case definition and reporting	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)		

Clear protocol for communication with hospital administration during times of overcrowding	0 (0.0)	4 (44.4)	2 (100.0)	5 (55.6)
Emergency-unit-specific emergency response protocol, including protocol for mass casualty incidents	1 (50.0)	4 (44.4)	1 (50.0)	5 (55.6)
Clinical management protocols				
Protocol for initial approach to ABCDs (airway, breathing, circulation, basic neurologic function)	2 (100.0)	7 (77.8)	0 (0.0)	2 (22.2)
Trauma care checklist	1 (50.0)	0 (0.0)	1 (50.0)	9 (100.0)
Medical resuscitation checklist	1 (50.0)	4 (44.4)	1 (50.0)	5 (55.6)
Protocol for neonatal resuscitation	0 (0.0)	6 (66.7)	2 (100.0)	3 (44.4)
Protocol for volume resuscitation of children and adults	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Protocol for adjusting interventions for malnourished patients	2 (100.0)	5 (55.6)	0 (0.0)	4 (44.4)
Protocol for post-exposure prevention of STI/HIV, emergency contraception, and counselling	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Protocol for management of labour and delivery in low risk women	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)
	Yes, N (%)		**No, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**

Condition-specific management protocols				
Asthma exacerbation	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Pneumonia	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Maternal haemorrhage	1 (50.0)	7 (77.8)	2 (50.0)	2 (22.2)
Sepsis	1 (50.0)	4 (44.4)	1 (50.0)	5 (55.6)
Diabetic ketoacidosis	2 (100.0)	5 (55.6)	0 (0.0)	4 (44.4)
Other condition	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Admission or discharge protocols				
Acuity-based internal transfer protocols to OR or ICU	1 (50.0)	3 (33.3)	1 (50.0)	6 (66.7)
Protocol for timely disposition from the emergency unit	2 (100.0)	4 (44.4)	0 (0.0)	5 (55.6)
Protocol for conveying information about discharge or disposition to the patient	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Hand-over protocols when transferring patients from one care provider to another	2 (100.0)	6 (66.7)	0 (0.0)	3 (33.3)
Outside transfer protocols				
Condition-specific transfer or referral protocols	1 (50.0)	6 (66.7)	1 (50.0)	3 (33.3)

Communication with receiving facility prior to transfer of patients with emergency conditions	1 (50.0)	9 (100.0)	1 (50.0)	0 (0.0)
Safety protocols				
Infection prevention and control protocols	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
Protocol for post exposure prophylaxis for health care workers	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)
Security protocols to protect staff, patients, and infrastructure from violence.	0 (0.0)	6 (66.7)	2 (100.0)	3 (33.3)
Protocol for managing hazardous exposures (including designated decontamination area)	0 (0.0)	3 (33.3)	2 (100.0)	6 (66.7)
Containment and disposal of sharps and biomedical waste	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
Plan to ensure emergency unit staff and patient safety if an incident occurs within the emergency unit (including space, transport, communications)	0 (0.0)	4 (44.4)	2 (100.0)	5 (55.6)
QUALITY IMPROVEMENT IN THE EMERGENCY UNIT				
Systematic process for collecting patient data that links condition, management and outcomes (e.g., trauma registry)	2 (100.0)	4 (44.4)	0 (0.0)	5 (55.6)
Regular meetings convened to use clinical data for quality improvement (e.g., morbidity and mortality conferences, preventable death panels)	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)

Tracking (e.g., clinical audit) to ensure that quality improvement actions (e.g., corrective action) are implemented after review meetings	2 (100.0)	9 (100.0)	0 (0.0)		0 (0.0)	
Clinical document template (e.g., standardised clinical chart)	2 (100.0)	7 (77.8)	0 (0.0)		2 (22.2)	
Visit to this emergency facility by a supervisor from outside the facility within the last 6 months	2 (100.0)	8 (88.9)	0 (0.0)		1 (11.1)	
Documentation from the most recent external supervisory visit	2 (100.0)	8 (88.9)	0 (0.0)		1 (11.1)	
	Yes, N (%)		**No, N (%)**		**No Data, N (%)**	
	Higher level	**Lower level**	**Higher level**	**Lower level**	**Higher level**	**Lower level**
Document provides feedback or comments on some aspect of emergency services	2 (100.0)	8 (88.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)

Signal Function Performances	**Adequate, N (%)**		**Some Availability, N (%)**		**Generally unavailable, N (%)**	
	Higher level	Lower level	Higher level	Lower level	Higher level	Lower level
VITAL SIGNS, AIRWAY, BREATHING						
Vital signs						
Vital signs triage area	1 (50.0)	9 (100.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)
Vital signs emergency unit	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)

Airway						
Manual airway manoeuvres	0 (0.0)	6 (66.7)	2 (100.0)	3 (33.3)	0 (0.0)	0 (0.0)
Use of suction	1 (50.0)	2 (22.2)	1 (50.0)	7 (77.8)	0 (0.0)	0 (0.0)
Placement of oro- or nasopharyngeal airway device	1 (50.0)	6 (66.7)	1 (50.0)	2 (22.2)	0 (0.0)	1 (11.1)
Placement of supraglottic device	0 (0.0)	1 (11.1)	0 (0.0)	4 (44.4)	2 (100.0)	4 (44.4)
Endotracheal intubation	2 (100.0)	3 (33.3)	0 (0.0)	4 (44.4)	0 (0.0)	2 (22.2)
Creation of surgical airway	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)	2 (100.0)	8 (88.9)
Breathing						
Saturation measured at triage	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)
Saturation measured in emergency unit	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Bronchodilator administered	1 (50.0)	4 (44.4)	1 (50.0)	3 (33.3)	0 (0.0)	2 (22.2)
Administration of oxygen	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Ventilation with BVM	1 (50.0)	8 (88.9)	1 (50.0)	0 (0.0)	0 (0.0)	1 (10.0)
Non-invasive mechanical ventilation	0 (0.0)	1 (11.1)	1 (50.0)	0 (0.0)	1 (50.0)	8 (88.9)
Invasive mechanical ventilation	0 (0.0)	0 (0.0)	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)
Needle decompression of tension ptx	0 (0.0)	2 (22.2)	1 (50.0)	1 (11.1)	1 (50.0)	6 (66.7)
Placement of chest tube	0 (0.0)	3 (33.3)	2 (100.0)	2 (22.2)	0 (0.0)	4 (44.4)
CIRCULATION INTERVENTIONS						
Volume Resuscitation						

Administration of oral rehydration	1 (50.0)	9 (100.0)	0 (0.0)	0 (0.0)	1 (50.0)	0 (0.0)
Peripheral IV placement	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Intraosseous access	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	9 (100.0)
Venous cutdown	0 (0.0)	5 (55.6)	1 (50.0)	2 (22.2)	1 (50.0)	2 (22.2)
Central venous line placement	0 (0.0)	2 (22.2)	1 (50.0)	6 (66.7)	1 (50.0)	1 (11.1)
IV fluid administration	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Adjustment of fluid resuscitation for malnutrition or severe anaemia	2 (100.0)	8 (88.9)	0 (0.0)	0 (0.0)	0 (0.0)	1 (11.1)
Urinary catheter placement	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Control of Bleeding						
External control of haemorrhage	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Wound packing and/or suture to control bleeding	2 (100.0)	7 (77.8)	0 (0.0)	2 (22.2)	0 (0.0)	0 (0.0)
Tourniquet placement	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Pelvic binding placement	0 (0.0)	2 (22.2)	2 (100.0)	3 (33.3)	0 (0.0)	4 (44.4)
Safe transfusion of blood performed	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Point of care ultrasound performed	0 (0.0)	1 (11.1)	1 (50.0)	6 (66.7)	1 (50.0)	2 (22.2)
Cardiac Interventions						
Pericardiocentesis performed	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	9 (100.0)
External defibrillation and/ or cardioversion performed	1 (50.0)	1 (11.1)	0 (0.0)	3 (33.3)	1 (50.0)	5 (55.6)

External cardiac pacing performed	0 (0.0)	0 (0.0)	1 (50.0)	2 (22.2)	1 (50.0)	7 (77.8)
Adrenaline available for administration	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
ECG performed and interpreted	0 (0.0)	4 (44.4)	1 (50.0)	3 (33.3)	1 (50.0)	2 (22.2)
Aspirin administered for ischemia	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Thrombolytic administration for MI	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	9 (100.0)
Unconscious Patient						
Point of care glucose testing for unconscious patients	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Glucose administered for hypoglycemia	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Lumbar puncture performed in unconscious patient	0 (0.0)	3 (33.3)	0 (0.0)	4 (44.4)	2 (100.0)	2 (22.2)
Seizure						
Protection from secondary injury of patient with seizure	1 (50.0)	3 (33.3)	0 (0.0)	4 (44.4)	1 (50.0)	2 (22.2)
Benzodiazepine administered for seizure	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
IV Magnesium admin for eclampsia	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Other						
Mental status examination performed	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Management of extreme temperature	1 (50.0)	2 (22.2)	0 (0.0)	3 (33.3)	1 (50.0)	4 (44.4)
Safe physical restraint performed when needed	1 (50.0)	7 (77.8)	1 (50.0)	2 (22.2)	0 (0.0)	0 (0.0)
Medication administered for agitation	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)

Procedural sedation performed	1 (50.0)	2 (22.2)	1 (50.0)	6 (66.7)	0 (0.0)	1 (11.1)
Relevant antidote administered for toxic exposure	0 (0.0)	0 (0.0)	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)
SEPSIS INTERVENTIONS						
IV antibiotics administered when needed	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
IV vasopressor administered	1 (50.0)	0 (0.0)	0 (0.0)	3 (33.3)	1 (50.0)	6 (66.7)
Diagnostic paracentesis performed	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Bedside minor surgical techniques for infectious source control	1 (50.0)	8 (88.9)	1 (50.0)	1 (11.1)	0 (0.0)	0 (0.0)
TRAUMA INTERVENTIONS						
Cervical spine immobilisation performed after trauma	2 (100.0)	4 (44.4)	0 (0.0)	3 (33.3)	0 (0.0)	2 (22.2)
Three-way dressing performed for sucking chest wound	0 (0.0)	0 (0.0)	1 (50.0)	1 (11.1)	1 (50.0)	8 (88.9)
Fasciotomy or escharotomy performed for compartment syndrome	0 (0.0)	2 (22.2)	1 (50.0)	2 (22.2)	1 (50.0)	5 (55.6)
Opiate analgesia administered	0 (0.0)	8 (88.9)	2 (100.0)	0 (0.0)	0 (0.0)	1 (11.1)
Fractures immobilised	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Closed reduction of fracture or dislocation performed	0 (0.0)	6 (66.7)	2 (100.0)	3 (33.3)	0 (0.0)	0 (0.0)
Antibiotics administered for open fractures	2 (100.0)	8 (88.9)	0 (0.0)	1 (11.1)	0 (0.0)	0 (0.0)
Initial wound care performance	2 (100.0)	9 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Tetanus vaccination or IVIg administered	1 (50.0)	5 (55.6)	1 (50.0)	4 (44.4)	0 (0.0)	0 (0.0)

OBSTETRIC INTERVENTIONS						
Emergency vaginal delivery performed	1 (50.0)	4 (44.4)	1 (50.0)	4 (44.4)	0 (0.0)	1 (11.1)
Uterotonic drug administered	1 (50.0)	4 (44.4)	0 (0.0)	4 (44.4)	1 (50.0)	1 (11.1)
Neonatal resuscitation performed	0 (0.0)	3 (33.3)	1 (50.0)	4 (44.4)	1 (50.0)	2 (22.2)

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5-6
Objectives	3	State specific objectives, including any prespecified hypotheses	5-6
Methods			
Study design	4	Present key elements of study design early in the paper	6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6-8
5-7Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8
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	8
Bias	9	Describe any efforts to address potential sources of bias	7
Study size	10	Explain how the study size was arrived at	n/a
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	8
		(*b*) Describe any methods used to examine subgroups and interactions	n/a
		(*c*) Explain how missing data were addressed	n/a
		(*d*) 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	8
		(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	8-10
		(b) Indicate number of participants with missing data for each variable of interest	n/a
Outcome data	15*	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	8-13

		clear which confounders were adjusted for and why they were included	
		(*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	8-13
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	16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	17
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	18

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.