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

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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 WHO; data were 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 10 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 was 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 patients with trauma. 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.

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

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 generalisable to other settings.

system level and in the global health discussion.[5–7] Recently, the WHO 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 programme, which was created in academic cooperation with programmes in South Africa, the USA 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 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 HEAT to the 11 hospitals in the area.

METHODS
Setting
The Kilimanjaro region is located in the north of Tanzania and is the home of one of 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 11 hospitals in the Kilimanjaro region of Northern Tanzania conducted in May 2021 (table 1). We used an exhaustive sampling approach to select all first-level, second-level and tertiary-level hospitals as well as health centres from the following districts: Moshi Municipal Council, Moshi District Council and Hai District Council.

Hospitals in Moshi Municipal Council were on average 4.9 km (3.7 km to 5.3 km) from the nearest higher level facility (figure 1). Hospitals in Moshi District Council averaged 30.9 km (12.0 km to 42.5 km) and 27.5 km (25.0 km 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 dichotomised 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 1 year. Each participant provided verbal and written informed consent. The interviews lasted on average 2 hours and 15 min and data were collected using the web-based data collection tool REDCap.[10]

The HEAT tool (online supplemental file 1), developed by the WHO in cooperation with the 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 three-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 (V.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

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 (eg, 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*	7800	1560
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	6106
Mawenzi Regional hospital*	Second level	Government	Present	Absent	1 702 207	5280	100 000	7836
Kilimanjaro Christian Medical Centre (KCMC)	Tertiary hospital	Private	Present	Present	15 000 000	17 753	30 000	7327
Moshi District Council								
TPC hospital	First level	Government	Absent	Absent	32 000*	643*	18 000	3199
Kibosho hospital	First level	Private	Present	Present	273 507*	2160*	48,730†	5104
Kilema hospital	First level	Private	Present	Absent	300 000*	2464*	18 058	3230
Marangu hospital	First level	Private	Present	Absent	300 000*	161*	22 697	3034
Hai District Council								
Hai District hospital	First level	Government	Present	Absent	336 000*	66*	57 862	3099
Machame hospital	First level	Private	Present	Absent	245 458*	500*	26 419	4074

*Indicates that the number was an approximation by hospital staff.
†Kibosho hospital established an emergency department only 1 month prior to this survey, so this number is a projection.
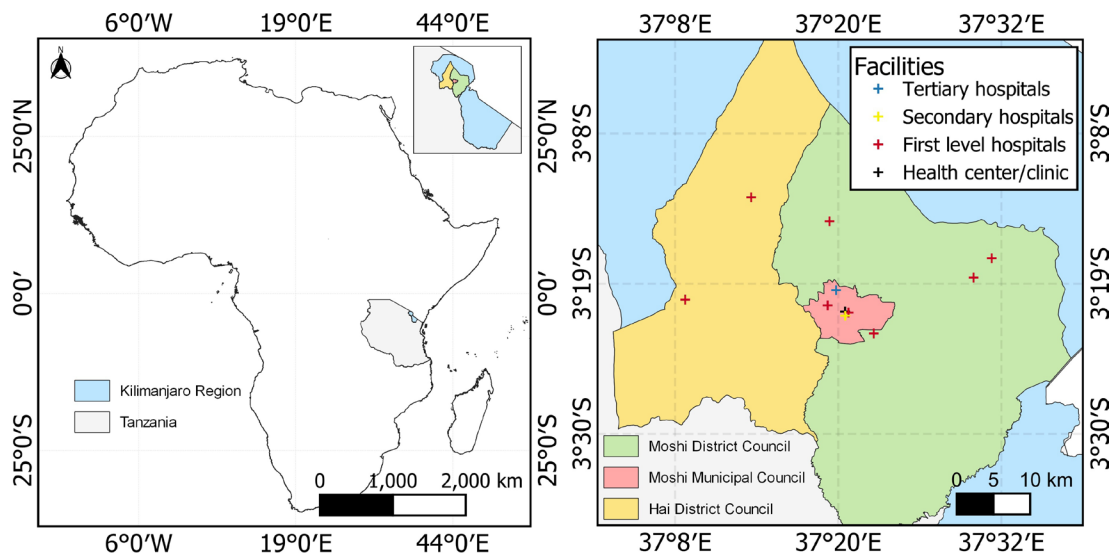ICU, Intensive Care Unit.

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

(63.6%) except one, which was run by an NGO. Full results may be reviewed in online supplemental file 2.

All hospitals were able to provide emergency services 24 hours a day, 7 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 (outpatient department) 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).

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 (online supplemental 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 eight nurses, 4 mid-level providers/advanced practice nurses and one trauma specialist and

the second of the first-level facilities had six nurses and six 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 (online supplemental 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

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)*	1 (9.1)
Cardiac monitoring in the emergency unit	1 (9.1)	5 (45.5)†	5 (45.5)
ECG in the emergency unit	1 (9.1)	7 (63.6)‡	3 (27.3)
Ultrasonography in the emergency unit	2 (18.2)	8 (72.7)‡	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)§	10 (90.9)
Glucose	9 (81.8)	2 (18.2)§	0
Malaria rapid diagnostic testing	4 (23.7)	8 (72.7)§	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%.
*Some availability means some drugs or equipment are lacking or the use of a cupboard instead of a trolley.
†Some availability means somewhere else in the hospital like in a ward or some are broken and not enough.
‡Some availability means somewhere else in the hospital like in the radiology department.
§Some availability means somewhere else in the hospital like in the laboratory, or sometimes out of stock.

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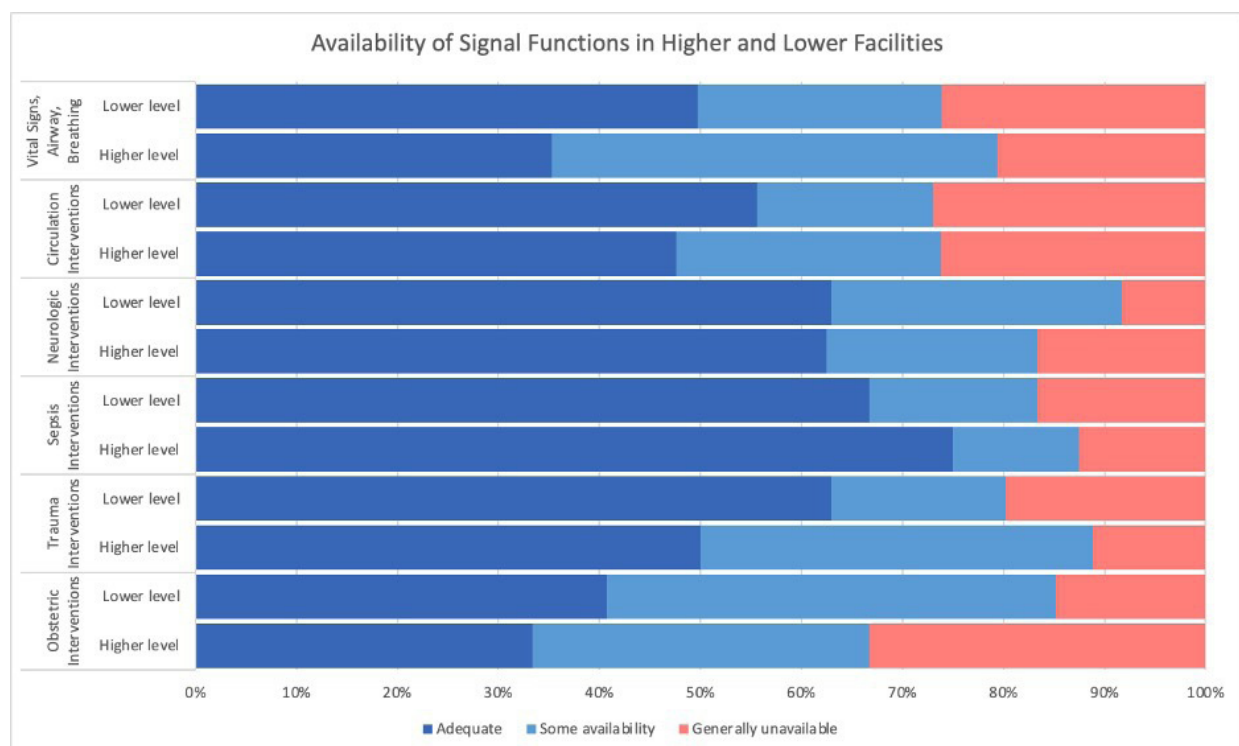
Figure 2 Signal function availability across higher-level and lower-level facilities.

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 hypoglycaemia 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 intravenous vasopressor use. All facilities stated they could provide fracture immobilisation and initial wound care for trauma interventions. Most indicated the ability to administer intravenous 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 with a previous study in Tanzania from 2013, which demonstrated that only 30% of the facilities had a triage area.[4] Moreover, 9 out of the 11 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 with 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 have 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 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 underdiagnosed 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 patients with trauma transferred from both first-level 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 (ST-elevation myocardial infarction) and trauma. Development of referral networks has 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 number 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. Third, 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 11 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 7 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 ACS and initial stabilisation manoeuvres in patients with trauma. 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 with a previous in-country assessment performed 8 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 use limited resources.

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Patient consent for publication Not applicable.

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