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A review of existing trauma and musculoskeletal impairment (TMSI) care capacity in East, Central, and Southern Africa

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ABSTRACT

Background: We conducted an assessment of orthopaedic surgical capacity in the following countries in East, Central, and Southern Africa: Burundi, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia, and Zimbabwe.
Methods: We adapted the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care with questions specific to trauma and orthopaedic care. In May 2013–May 2014, surgeons from the College of Surgeons of East, Central and Southern Africa (COSECSA) based at district (secondary) and referral (tertiary) hospitals in the region completed a web-based survey. COSECSA members contacted other eligible hospitals in their country to collect further data.
Findings: Data were collected from 267 out of 992 (27%) hospitals, including 185 district hospitals and 82 referral hospitals. Formal accident and emergency departments were present in 31% of hospitals. Most hospitals had no general or orthopaedic surgeons or medically-qualified anaesthetists on staff. Functioning mobile C-arm X-ray machines were available in only 4% of district and 27% of referral hospitals; CT scanning was available in only 3% and 26%, respectively. Closed fracture treatment was offered in 72% of the hospitals. While 20% of district and 49% of referral hospitals reported adequate instruments for the surgical treatment of fractures, only 4% and 10%, respectively, had a sustainable supply of fracture implants. Elective orthopaedic surgery was offered in 29% and Ponseti treatment of clubfoot was available at 42% of the hospitals.
Interpretation: The current capacity of hospitals in sub-Saharan Africa to manage traumatic injuries and orthopaedic conditions is significantly limited. In light of the growing burden of trauma and musculoskeletal impairment within this region, concerted efforts should be made to improve hospital capacity with equipment, trained personnel, and specialist clinical services.

Introduction

Trauma and musculoskeletal impairment (TMSI) conditions are the most common cause of severe long-term pain and physical disability worldwide [1]. TMSI includes a diverse spectrum of conditions from those of acute onset, such as limb fractures, sprains, and strains, to chronic disorders such as osteoarthritis, rheumatoid arthritis, and low back pain. The prevalence of most of these conditions naturally increases with age [2]. As the proportion of the elderly in the world population is increasing [3], the burden of TMSI will continue to grow and will likely have profound economic, political, and social consequences worldwide.

Injuries make up a significant component of TMSI globally, accounting for roughly the same number of deaths each year as HIV, TB, and malaria combined [4,5]. Injuries also require a substantial burden of global public health resources, as they are the leading cause of death among young adults aged 15–29 years [6]. Nearly 90% of the world's road traffic fatalities occur in low-income and middle-income countries (LMICs), even though these countries have only approximately half of the world's vehicles [4,7]. Half of those dying from road traffic accidents are "vulnerable road users" such as pedestrians, cyclists, and motorcyclists [4,8,9]. Road traffic injuries have been neglected from the global health agenda for many years, despite being predictable and largely preventable.

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Evidence from many countries shows that dramatic successes in preventing road traffic crashes can be achieved through concerted efforts that involve improvement of the health system [4].

The College of Surgeons of East, Central, and Southern Africa (COSECSA) was established in 1999 with the primary objective of advancing education, training, standards, research, and practice in surgical care, including musculoskeletal care, in this region [10]. The COSECSA region is comprised of the following ten countries: Burundi, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia, and Zimbabwe. These countries have a total combined population of approximately 318 million, and spend an average of US$44 per person on health care each year [11]. Furthermore, there is a significant shortage of health workers within the region. It is estimated that there are only about 1390 qualified surgeons practicing in the region (around 0.4 per 100,000 population) [10]. This is extremely low compared to the United Kingdom, which has 19,116 surgeons serving a population of 63.7 million (around 30 per 100,000 population) [12]. Even if the actual number of surgeons in this region of Africa was doubled—or even multiplied by 5—this would likely not be sufficient to meet the acute surgical needs in the region or the backlog of unmet surgical needs [13,14]. The capacity of health institutions in terms of the provision of equipment and other trained health personnel within the region remains largely unexplored [15–19].

In this paper, we present the results of a baseline analysis of TMSI care capacity in district (secondary) and referral (tertiary) hospitals across the ten COSECSA countries. There has been no previous attempt to systematically evaluate the existing capacity of hospitals in the region to manage TMSI and, in particular, the surgical capacity of these hospitals. This baseline information about the ability to cope with the current burden of TMSI is essential for understanding present-day needs. The analysis also provides a foundation for making projections about future needs and for estimating the proportion of existing TMSI burden that could be eliminated through expanded access to surgical care and rehabilitation [17,19].

Methods

This study was approved by the education, scientific and research committee of the College of Surgeons of East, Central and South Africa (COSECSA). All data collated was through members of the College of Surgeons of East, Central and South Africa who provided written informed consent. No identifiable information of institutions or participants was collected, nor was any identifiable information reported in the manuscript.

We searched the websites of the ministries of health in all ten COSECSA countries for lists of all public and non-profit health institutions, aiming to identify all district and referral hospitals managed by the country's Ministry of Health or by a not-for-profit charitable organisation. Private for-profit hospitals were excluded from consideration. We defined hospital institutions in accordance with the descriptions set out by Mulligan et al. [20], whereby district (secondary) hospitals were defined as health institutions in a country that offer the most basic of surgical services and may receive referrals from lower levels of care, such as primary healthcare clinics. Similarly, we defined referral (tertiary) hospitals as health facilities which offer more advanced specialised care from highly-skilled personnel, may possess more sophisticated diagnostic techniques and advanced therapeutic technologies, and receive referrals from district hospitals or other lower levels of care. These institutions are often referred to as provincial, central, or teaching hospitals. A referral was defined as any process in which health care providers at different levels of the health system who lack the skills and/or the facilities to manage a given clinical condition seek the assistance of providers who are better equipped or specially trained to guide them in managing or to take over responsibility for a particular episode of a clinical condition in a patient [21]. In total, we identified 992 hospitals that appeared to meet the eligibility criteria.

The assessment tool was a survey based on a modification of the WHO Tool for Situational Analysis to Assess Emergency and Essential Surgical Care [22] with additional questions specific to trauma and orthopaedic care. Data were collected from May 2013 to May 2014 by the survey team in collaboration with COSECSA Council country representatives and members. Data collectors administered the survey through telephone or email contact with hospital administrators and other key hospital personnel. In addition, data were collected directly from surgeons around the region through emailing a link to the web-based survey link to all COSECSA members and making the survey publicly available through the COSECSA website. If there was no response, then the hospital was re-contacted. The survey responses were entered onto a web-based survey platform.

Results

We received completed surveys from 267 of the 992 total district and referral hospitals, for a response rate of 26.9%.

Infrastructure

On average, referral hospitals had 250 beds and district hospitals had about 120 beds (Tables 1–3). On average 90% of the hospitals had at least one operating theatre, but only about 30% had a dedicated accident and emergency unit. More than half of the referral hospitals and one-third of the district hospitals had a rehabilitation unit for TMSI patients. Few facilities had limb prosthesis manufacturing units. Clinical laboratory capabilities varied, with most hospitals able to check complete blood counts and erythrocyte sedimentation rates but less than 40% able to measure C-reactive protein.

Table 1
Hospital resources reported by infrastructure.

Health Institutions		Referral ($n = 82$)	District ($n = 185$)
Infrastructure	Median (IQR) bed capacity	250 (123–450)	120 (70–200)
	Mean (SD) bed capacity	368 (397)	148 (95)
	Number (%) of hospitals with operating theatres	78 (95.1)	130 (83.8)
	Mean (SD) number of theatres per hospital	2.8 (2.3)	2.1 (1.9)
	Number (%) of hospitals with theatres with working pulse oximeters	76 (92.7)	150 (81.0)
	Number (%) of hospitals with dedicated accident and emergency (A&E) units	28 (34.1)	54 (29.2)
	Number (%) of hospitals able to check complete blood count (CBC)	80 (97.6)	171 (92.4)
	Number (%) of hospitals able to check erythrocyte sedimentation rate (ESR)	75 (91.5)	155 (83.8)
	Number (%) of hospitals able to check C-reactive protein (CRP)	33 (40.2)	69 (37.3)
	Number (%) of hospitals with rehabilitation units	48 (58.5)	66 (35.7)
	Number (%) of hospitals with limb prosthesis manufacturing units	13 (15.9)	27 (14.6)

Table 2
Hospital resources reported by orthopaedic equipment and procedures.

Health Institutions	Referral	Health Institutions	Referral
Orthopaedic equipment	Number (%) of hospitals with X-ray machines	81 (98.8)	163 (88.1)
	Mean (SD) number of X-ray machines per hospital	2.2 (1.3)	1.1 (0.5)
	Number (%) of facilities with X-ray machines functioning nearly all the time	74 (90.2)	138 (74.6)
	Number (%) of hospitals with CT scanner	24 (29.3)	9 (4.9)
	Mean (SD) number of CT scanners per hospital	0.3 (0.5)	0.1 (0.2)
	Number (%) of facilities with CT scanner functioning nearly all the time	21 (25.6)	6 (3.2)
	Number (%) of hospitals with C-Arm	33 (40.2)	9 (4.9)
	Mean (SD) number of C-Arms per hospital	0.5 (0.8)	0.1 (0.3)
	Number (%) of facilities with C-Arms functioning nearly all the time	22 (26.8)	7 (3.8)
	Number (%) of hospitals with adequate orthopaedic instruments to treat orthopaedic trauma	40 (48.8)	37 (20.0)
	Number (%) of hospitals with a sustainable supply of implants for internal fixation of fractures some of the time	14 (17.1)	23 (12.4)
	Number (%) of hospitals with a sustainable supply of implants for internal fixation of fractures nearly all the time	8 (9.8)	7 (3.8)
Orthopaedic procedures	Number (%) of hospitals offering closed fracture treatment	65 (79.3)	127 (68.6)
	Number (%) of hospitals able to perform amputations	55 (67.1)	111 (60.0)
	Number (%) of hospitals offering internal fixation of fractures	28 (34.1)	49 (26.5)
	Number (%) of hospitals performing elective orthopaedic surgery	27 (33.9)	50 (27.0)
	Number (%) of hospitals offering treatment for acute osteomyelitis and septic arthritis	49 (59.8)	98 (53.0)
	Number (%) of hospitals offering Ponseti clubfoot treatment	35 (42.7)	78 (42.2)

Orthopaedic equipment

More than 90% of the hospitals reported having an X-ray machine, but only about 80% had at least one X-ray machine functioning nearly all of the time. About 25% of referral hospitals had a working CT scanner, and about 25% had a functioning C-arm. These diagnostic tools were rarely available in district hospital environments. About half of referral hospitals and 20% of district hospitals reported having adequate orthopaedic surgical instruments, even though very few reported having a sustainable supply of implants for internal fixation of fractures.

Personnel

About 42% of referral hospitals and 33% of district hospitals had a qualified surgeon on staff; only 23% and 15%, respectively, had a qualified orthopaedic surgeon on staff. Few hospitals had visiting surgeons. About 48% of referral hospitals and 32% of district hospitals had a doctor on staff specialising in the provision of orthopaedic care. About 26% and 21%, respectively, had an orthopaedic clinical officer. Clinical officers' training varies in the different countries. Although they are not medical doctors, they play a pivotal role in health care delivery in sub-Saharan Africa. About half of the hospitals had a physiotherapist on staff and about half had at least one rehabilitation technician. Few hospitals had a qualified trained anaesthetist. In a majority of these facilities, anaesthesia services were provided by clinical officers.

Orthopaedic procedures

About 80% of referral hospitals and 70% of district hospitals offer closed fracture treatment. About 67% and 60%, respectively, can

Table 3
Hospital resources reported by personnel.

Health institutions	Referral	Health institutions	Referral
Personnel	Number (%) of hospitals with at least one surgeon	34 (41.5)	62 (33.5)
	Median (IQR) number of surgeons per facility	0 (0–2.5)	0 (0–1)
	Mean (SD) number of surgeons per facility	2.6 (4.6)	1.4 (3.0)
	Number (%) of hospitals with at least one orthopaedic surgeon	19 (23.2)	27 (14.6)
	Mean (SD) number of orthopaedic surgeons per facility	0.5 (0.9)	0.3 (0.9)
	Number (%) of hospitals with visiting surgeon	17 (20.7)	26 (14.1)
	Number (%) of hospitals with at least one doctor providing orthopaedic care	39 (47.6)	60 (32.4)
	Median (IQR) number of other doctors providing orthopaedic care per facility	0 (0–2)	0 (0–1)
	Mean (SD) number of other doctors providing orthopaedic care per facility	1.2 (1.9)	1.6 (5.8)
	Number (%) of hospitals with at least one orthopaedic clinical officer	21 (25.6)	38 (20.5)
	Median (IQR) number of orthopaedic clinical officers (if applicable) per facility	0 (0–1.5)	0 (0–2)
	Mean (SD) number of orthopaedic clinical officers per facility	1.3 (3.1)	1.0 (2.3)
	Number (%) of hospitals with at least one physiotherapist	46 (56.1)	75 (40.5)
	Median (IQR) number of physiotherapists per facility	1 (0–3)	0 (0–2)
	Mean (SD) number of physiotherapists per facility	2.2 (3.4)	1.9 (5.7)
	Number (%) of hospitals with at least one rehabilitation technician	44 (53.7)	71 (38.4)
	Median (IQR) number of rehabilitation technicians per facility	1 (0–2)	0 (0–2)
	Mean (SD) number of rehabilitation technicians per facility	1.4 (1.7)	1.7 (3.9)
	Number (%) of hospitals with at least one anaesthesiologist	16 (19.5)	26 (14.1)
	Median (IQR) number of anaesthesiologists per facility	0 (0)	0 (0)
	Mean (SD) number of anaesthesiologists per facility	0.6 (1.8)	1.0 (4.4)
	Number (%) of hospitals with at least one anaesthetic clinical officer	62 (75.6)	131 (70.8)
	Median (IQR) number of anaesthetic clinical officers per facility	3 (1–6)	2 (1–4)
	Mean (SD) number of anaesthetic clinical officers per facility	4.2 (5.0)	3.8 (5.2)

perform amputations. About one-third of referral hospitals and one-quarter of district hospitals offer internal fixation of factures. Less than one-third of hospitals offer elective orthopaedic surgery. The most common reasons that the hospitals were unable to do surgical procedures listed were shortages of specialised surgeons and required instruments and implants. Ponseti (non-surgical) clubfoot treatment was offered in about 42% of all hospitals.

Discussion

This is the first in-depth study of TMSI care capacity in secondary and tertiary hospitals in sub-Saharan Africa, and it demonstrates that there is a significant imbalance between the TMSI needs of the population and the resources that are available for TMSI care. The survey results highlight the urgent need for increased access and investment towards acute and emergency services and rehabilitation facilities; routine and advanced surgical equipment; highly-trained medical, surgical, and allied health personnel; and critical orthopaedic procedures. The demands for these services will only grow as the burden of trauma and non-communicable diseases in this region are [5,23] projected to increase over the years. McIntyre et al. used three dimensions to define barriers to improving care within low and middle income countries, namely affordability, availability and acceptability [24,25]. In broad terms, this refers to structural availability of facilities, the financial affordability of the direct and indirect costs associated with accessing health care; and the social/cultural acceptability relating to patient beliefs, perceptions, and expectations. Our study focuses on the availability elements, and recommends the following priority areas for improving access to TMSI care within the region.

First, there is a critical need to train more healthcare workers in general and to offer advanced training for surgeons, orthopaedic surgeons, orthopaedic clinical officers, physiotherapists, rehabilitation technicians, anaesthetists, and other clinical care providers. The need for surgical training is particularly acute, since more than half of district and referral hospitals in our study had no access to a general surgeon, orthopaedic surgeon, or physician specialising in orthopaedic care on staff. This is partly because a majority of hospital based TMSI care in sub-Saharan Africa is provided by non specialised physicians or by orthopaedic clinical officers. Studies have demonstrated that well-trained generalist doctors such as family physicians can improve access to acute services in the rural regions, thereby improving surgical output and operative capacity [26,27]. However a majority of these studies have focused on emergency obstetric and surgical procedures, with less emphasis on common orthopaedic and trauma procedures [28,29]. There are in many sub-Saharan African countries good sustainable training programmes for surgical personnel, both medically and non-medically qualified [13,30,31]. One example is COSECSA, which offers postgraduate training in adult and paediatric orthopaedic surgery, and also offers specialist surgical qualifications through a series of written and practical examinations [10]. Similar options for speciality training and certification in other fields, such as physiotherapy exist but need to be expanded in order to raise the quality of care available to TMSI patients.

Second, all hospitals, district as well as referral, need to have functioning X-ray machines and all referral hospitals need to have functioning CT scanners and mobile C-arms. Without reliable access to advanced imaging technologies, correct diagnosis and subsequent planning and execution of treatment is severely limited in many cases [32–34]. In addition, all hospitals offering surgical care must have reliable access to the basic surgical equipment required for managing orthopaedic trauma, including, where appropriate, implants for internal fixation of fractures. Increasing the capacity of district hospitals to provide surgical care for trauma patients will improve patient outcomes by reducing the need for transfer to a referral hospital and by allowing referral hospitals to focus on providing care for complex cases that cannot be managed at the district level [34,35].

Third, more district and referral hospitals need to offer dedicated A&E units for managing early care of trauma patients, and dedicated rehabilitation units for providing long-term care of TMSI patients. Appropriate rehabilitation therapy after an injury or other form of TMSI can prevent long-term disability [36–40]. Expanding rehabilitation services at district hospitals will be particularly important for the rural residents for whom district hospitals are the most accessible trauma care facilities. This study does not look at community provision of TMSI treatment or rehabilitation services, but community-based services will need to be considered as part of any rehabilitation expansion plan.

Lessons can be learnt from experiences of other colleagues in implementing improved health care service in LMICs (Lower Middle Income Countries). Banu et al. report on their work in the field of paediatric surgery in rural Bangladesh [41]. As in many LMICs, there was disparity between access to surgical health care and disease burden within the population. Centralised referral centres being situated in urban centres, meant a significant proportion of patients living in rural areas had poor access. The authors overcame this problem (in part) by setting up an outreach service (mobile surgical team) to provide surgical services to rural children by utilising existing facilities of primary and secondary care centres. However trauma workload is unpredictable and is difficult to implement effectively as an outreach service. A further point to consider is that all though these initiatives succeed in delivering non urgent point-of-care need, they are less successful in building surgical operative capacity within rural regions [26].

Clarke et al. provide an overview of the challenges faced in LMICs pointing to the fact that poor patient outcomes primarily reflect systematic failures rather than individual failures [42]. Without an overarching framework to provide a national structure, local strategic planning aimed at quality improvement risks becoming haphazard, ineffectual and even counter-productive.

Many high income countries have recently developed national trauma networks with regional highly developed multispecialty major trauma centres and there is evidence that patient outcomes are significantly improved [43]. Hardcastle has published a detailed analysis of the components of the trauma system in South Africa, which is a middle income country, but which covers every aspect of care ranging from prevention to rehabilitation after trauma [44].

Hardcastle highlights the differences between sub-Saharan Africa trauma burden and trauma type and that seen in US and Europe [45], and the various factors that influence setting up health systems, such as political will, private sector participation, proper data management and post-trauma support. In a separate study, Clarke et al. highlight the magnitude of the task ahead if one has to deliver an efficient and effective surgical care in sub-Saharan Africa, with particular reference to rural regions [46]. Clarke demonstrates the tensions that often exist between various stakeholders involved in surgical care (rural doctors, surgeons, ancillary staff, researchers, educators and administrators). Some of these conflicts relate to the lack of management training included in medical curricula, or arise when management interventions or research are perceived as an imposition on surgical staff. To mitigate this, Clarke suggests a framework that enables planners to contextualise the strategic planning process against various components of the healthcare system, to plan appropriately and to evaluate the improvements over time. Clarke reports benefits in using this framework in his local rural district in South Africa, in streamlining efforts and improving outcomes in certain key areas.

In this paper, we have looked at anonymised data from nine different countries and we do not feel it appropriate to comment on specific country improvements, rather we recommend that any strategy should address the three key areas of personnel, equipment, and infrastructure.

Our analysis had several limitations. We are not certain that our list of eligible health facilities was inclusive of all eligible health institutions in the region at the time of the data collection, as some hospitals may have been omitted from the lists provided by the countries' health ministries. Data were collected for only 27% of the eligible hospitals in the region, with the low response rate mainly due to scale of the task and difficulty in establishing contact with key informants in all eligible hospitals. Some of the non-responding hospitals likely had even more resource limitations than the participating facilities, which may mean that our study likely overestimates the infrastructure, equipment, personnel, and services available at district and referral hospitals in the region. Furthermore, we were unable to perform site inspections in order to verify the answers provided.

Despite these challenges, this baseline survey of surgical resources in the COSECSA region provides a starting point for identifying health system priorities and for planning further surveys to assess progress toward achieving the goals that are set by ministries of health and professional organisations for improving TMSI care in sub-Saharan Africa.

Authors contribution

Linda Chokotho—Literature search, data collection, data analysis, data interpretation and draft of Manuscript; Kathryn H. Jacobsen—Critique of analysed data and revision of manuscript; David Burgess—Critique of analysed data and revision of manuscript; Mohamed Labib—Critique of analysed data and revision of manuscript; Grace Le—Data collection and revision of manuscript; Noel Peter—Critique of analysed data and revision of manuscript; Christopher B.D. Lavy—Developing the concept, critique of analysed data and revision of manuscript; Hemant Pandit—Developing the concept, critique of analysed data and revision of manuscript.

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Conflict of interest statement

Dr Linda Chokotho, Dr Kathryn H. Jacobsen, Dr David Burgess, Dr Mohamed Labib, Miss Grace Le, Dr Noel Peter and Dr Christopher B.D. Lavy report grants from the Health Partnership Scheme funded through the Tropical Health Education Trust (THET) during the conduct of the study. Dr. Hemant Pandit reports grants from the Health Partnership Scheme (THET), during the conduct of the study. He also reports grants from UKIERI and personal fees from Biomet outside the submitted work.

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