

Evaluating Trauma Care Capabilities using the Essential Trauma Care Guidelines of the World Health Organization

Cross-sectional study of primary health centres in Muscat, Oman

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ABSTRACT: Objectives: This study aimed to evaluate trauma care capabilities at the primary care level in Muscat, Oman, using World Health Organization guidelines. **Methods:** This descriptive cross-sectional study was conducted between January and March 2015 at eight primary health centres in Seeb. An English-language questionnaire was distributed to the medical officer or nurse in-charge at each centre to determine the number of staff, total population being served, number of emergency trauma cases and availability of ambulances. Subsequently, 10 doctors from each health centre were randomly selected to assess the availability of physical resources as well as their trauma skills and knowledge. **Results:** There were limited physical and human resources for the management of trauma and a complete absence of trauma administrative functions, such as local trauma registries or quality improvement activities. **Conclusion:** This study highlighted the need to introduce national guidelines and improve the delivery of trauma services in Oman.

Keywords: Primary Healthcare; Trauma; Emergency Medicine; Capacity Building; Health Resources; Delivery of Health Care; Oman.

ADVANCES IN KNOWLEDGE

- There is limited physical and human resources for the management of trauma cases in primary healthcare centres.
- There is a need for trauma administrative functions such as trauma registries.

APPLICATION TO PATIENT CARE

- Evaluation of trauma capabilities in primary healthcare suggest that patients with serious trauma should be directed to a trauma centre.

TRAUMA IS A MAJOR CAUSE OF DEATH AND disability worldwide, with the majority of preventable deaths occurring in primary care settings.^{1,2} In particular, road traffic crashes (RTCs) are a common yet avoidable cause of trauma and represent a considerable economical and logistical burden on the healthcare system.² According to a report by the World Health Organization (WHO), the total number of RTC-related deaths worldwide was 1.35 million in 2018.³ Moreover, the risk of dying due to a road traffic injury was highest in the African, South-East Asian and Eastern Mediterranean regions at 26.6, 20.7 and 18 deaths per 100,000 individuals, respectively.³

In 2004, the WHO published a set of international guidelines for essential trauma care (ETC), resulting in a checklist of 260 items outlining the personnel-related (i.e. training, skills and sufficient staffing) and physical (i.e. equipment and supplies) resources necessary for the delivery of high-quality trauma care.^{4,5} These guidelines provide a standardised template to assess trauma care capabilities in nations worldwide. Various countries have since adopted these guidelines in an

attempt to identify affordable and sustainable methods to strengthen their capabilities and improve national trauma systems.^{6,7}

In Oman, healthcare services are provided in a three-tiered-system at the primary (i.e. primary health centres providing both, acute and chronic care), secondary (i.e. regional referral hospitals) and tertiary care levels (i.e. tertiary referral hospitals and one university hospital in Muscat, the capital city). In 2016, Oman had a total of 108 primary care centres, of which 28 were located in Muscat; however, the majority of these centres in Oman do not have beds or intensive care units.⁸ Each centre is staffed by a variety of healthcare personnel, including general practitioners (GPs), nurses, dentists, laboratory technicians, pharmacists and paramedical staff.⁸ In terms of trauma management, primary health centres provide initial care and stabilisation before referring cases to secondary or tertiary hospitals.⁹ As with other Gulf Cooperation Council countries, Oman has a high RTC-related death rate with 16.1 deaths per 100,000 individuals.³ A recent pilot study also showed that the

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distribution and quality of trauma centres in Oman was inadequate in terms of their proximity to high-incidence RTC sites.¹⁰

Currently, no unified national guidelines regarding trauma treatment exist in Oman, with each individual centre or hospital following its own policies based on different international guidelines. Moreover, to the best of the authors' knowledge, no studies on national trauma care capabilities have been conducted at the primary care level yet. This study, therefore, aimed to assess trauma care capabilities with regards to the WHO guidelines for ETC at selected primary health centres in Muscat.⁵ These findings may be useful in informing the planning and allocation of health resources in Oman.

Methods

This cross-sectional study was conducted from January to March 2015 at eight primary care centres in Muscat Governorate. Overall, this governorate consists of six *wilayats* (counties); of these, Seeb was selected because it was the most populated, had the highest speed limit compared to the other *wilayats* (120 km/hour) and had the greatest number of primary centres ($n = 8$). A convenience sample of 10 doctors of any nationality or specialty were recruited from each healthcare centre. Three English-language data collection tools were used to evaluate the current status of trauma care capabilities at the selected primary care centres.

The first tool was a structured seven-item questionnaire distributed to the medical officer or nurse in-charge at each health centre. The aim of the questionnaire was to determine general demographic information as well as the number of staff, total population being served, number of emergency cases (especially trauma cases) and availability of ambulances at each centre.

The second tool consisted of a modified 32-item version of the WHO ETC checklist to assess the availability of equipment required for managing trauma cases.⁵ Each item was rated from 0 to 3 as either not applicable at that level (N/A), absent but should be present (score of 0), inadequate (score of 1), partially adequate (i.e. present but not assured, consistently available or readily available; score of 2) or adequate (i.e. present and used appropriately; score of 3).⁵ The third tool consisted of a modified 15-item version of the WHO ETC checklist to evaluate skills and knowledge regarding trauma emergency management among the sample of recruited doctors.⁵ In order to ensure the reliability of the responses, participants were advised not to discuss the questions among

themselves to avoid peer influence. A pilot study was conducted in another *wilayat* in the same governorate in order to ensure the validity of the tools and the level of understanding of the rating scale. Follow-up interviews with the medical officers and nurses in-charge at each centre were also conducted to ensure their understanding of the rating scale as well as to cross-validate the collected data.

The data analysis was performed using the Statistical Package for the Social Sciences (SPSS), Version 25.0 (IBM Corp., Armonk, New York, USA). The results were presented using descriptive statistics. Means and standard deviations were reported for continuous variables, while frequencies and percentages were reported for categorical variables. The association of the independent variables with the outcome variables was estimated using Kruskal-Wallis and Mann-Whitney-U tests. The two-tailed significance level was set at $P \leq 0.050$.

Ethical approval for this study was obtained from the research ethics committee of the Directorate General of Health Services of the Ministry of Health in Muscat. Informed consent was obtained from the participants prior to taking part in the study. Moreover, confidentiality of the collected data and anonymity of the participants was ensured at all times.

Results

The total population being served at each centre ranged from 25,000–145,000 individuals. The number of patient visits ranged from 67,000–93,755 per year; of these, approximately 800–1,810 were emergency visits, including trauma cases [Table 1].

In terms of the availability of physical resources for basic airway management and breathing, none of the health centres reported shortages of advanced airway breathing devices, including endotracheal tubes (75%), bag valve masks (63%) and laryngoscopes (63%). However, pulse oximeters were available at only three centres (38%) and none of the centres had arterial blood gas analysers, chest tubes, cricothyrotomy sets or ventilators [Figure 1A]. With regards to equipment for circulation management, all centres had intravenous access sets and fluids (i.e. crystalloids); however, there was a lack of resources for venous surgical (25%) and interosseous access devices (13%) [Figure 1B]. Moreover, even where this equipment was available in two and one health centre, respectively, it had never been used. This was reported to be due to the lack of staff experience with such devices.

In addition, there was a deficit of physical resources for basic trauma investigations. For example,

Table 1: General status of primary health centres in Seeb, Muscat, Oman (N = 8)

Indicator	Range
Doctors per health centre	11–16
Specialists per health centre	2–3
Nurses per health centre	14–20
Ambulances*	0–6
Patient visits per year	67,000–93,755
Total population	25,000–145,000
Emergency† visits per year	800–1,810

*Ambulances covering Seeb region and sent to specific health centres on demand.

†Comprising all emergency cases, including trauma.

each health centre had only one electrocardiography (ECG) machine which was deemed only partially adequate to meet demand due to frequent breakdown. Moreover, although all of the centres had haemoglobin assays, only 13% reported this to be adequate, with 63% deeming this resource as only partially adequate because it was not available at all times. The availability of splints for fracture immobilisation was high; however, 58% of centres reported their availability to be only partially adequate. In addition, electrolyte assays, blood transfusion equipment and fluid warmers were not available at any of the centres. Only 87% of the centres had adequate urinary catheters. While plain radiography technology was present in all centres, 75% reported it to be inadequate with a complete lack of portable X-ray machines. Similarly, while all of the centres had ultrasound machines, these were not used for trauma investigation or treatment purposes.

Subsequently, 10 doctors at each health centre were surveyed to determine their skills in handling trauma cases. Of the 80 doctors assessed, 66 (82%) were female and 14 (18%) were male. The majority were of Omani nationality (81%). In terms of their medical certifications, 69% had a Doctor of Medicine degree, 14% had a Bachelor of Medicine and Bachelor

of Surgery degree and 17% had a Membership of the Royal College of General Practitioners qualification. In addition, 45% and 55% of the doctors were certified in basic life support and advanced cardiac life support, respectively. However, only one doctor had valid qualifications for paediatric advanced life support and advanced trauma life support (ATLS). A total of 46 doctors (58%) declared that they had previously taken part in trauma-related continuing medical education activities.

In terms of basic airway management and breathing skills, most doctors were consistently able to administer supplemental oxygen (88%), perform chin lift/jaw thrust manoeuvres (71%), put patients in the recovery position (68%), perform assisted ventilation (68%), insert an oropharyngeal airway (52%) and perform a log roll (43%). However, very few were consistently able to practise endotracheal intubation (8%), perform needle thoracotomy (4%) or insert a chest tube (3%) [Figure 2A]. Critically, some of the doctors reported that they lacked any knowledge of how to perform a needle thoracotomy (18%) or a log roll (15%) or insert a chest tube (10%), while 1% could not put patients in the recovery position or insert an oropharyngeal airway [Figure 2B].

Regarding the doctors' circulation management skills, the majority could consistently insert IV access devices (91%), monitor circulation (82%) and assess shock (79%). Nevertheless, most were unable to use intraosseous vascular access devices or perform peripheral venous cutdown procedures, with the exception of five and three doctors, respectively. Only four doctors (5%) were able to control external haemorrhage by deep wound packing or knew how to wrap potential pelvic fractures [Figure 3]. Basic orthopaedic skills (i.e. fracture immobilisation) were present in 47% of doctors; however, none could perform more advanced orthopaedic interventions. The majority of the doctors (82%) were familiar with the Glasgow Coma Scale score and could recognise altered mental status. However, 10% did not know

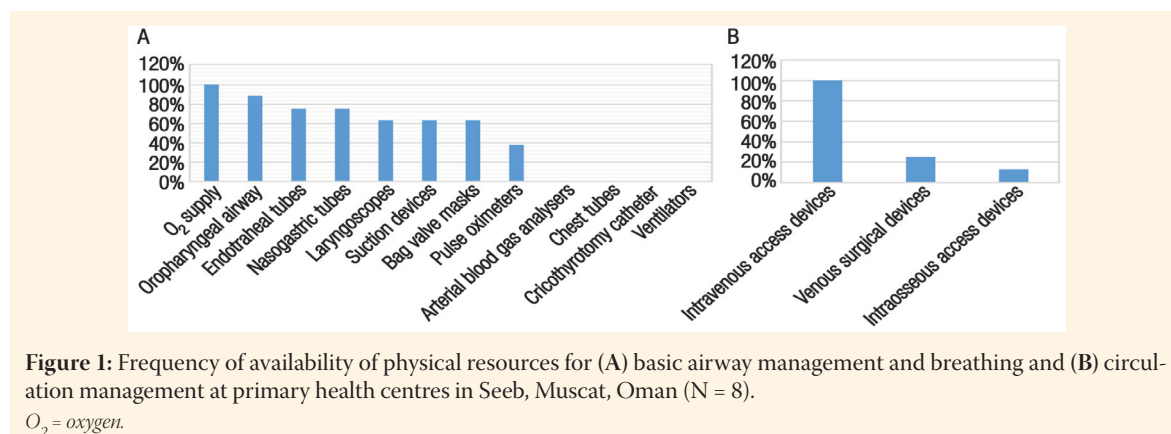


Figure 1: Frequency of availability of physical resources for (A) basic airway management and breathing and (B) circulation management at primary health centres in Seeb, Muscat, Oman (N = 8).

O₂ = oxygen.

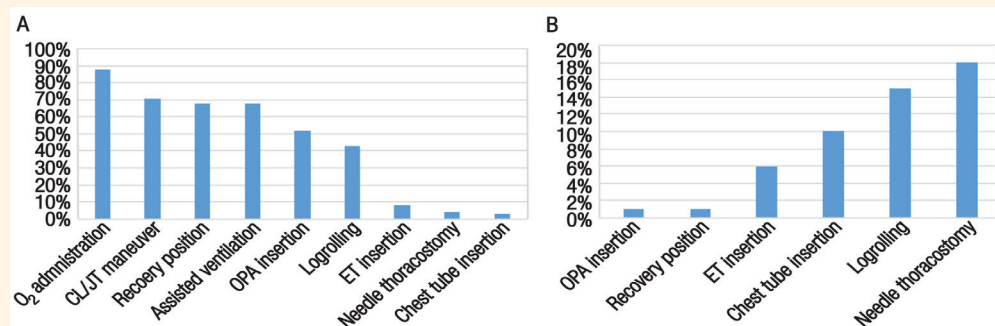


Figure 2: Frequency of (A) consistent knowledge and (B) complete lack of knowledge of basic airway management and breathing procedures among doctors working at primary health centres in Seeb, Muscat, Oman (N = 80).

O₂ = oxygen; CL/JT = chin lift/jaw thrust; OPA = oropharyngeal airway; ET = endotracheal tube.

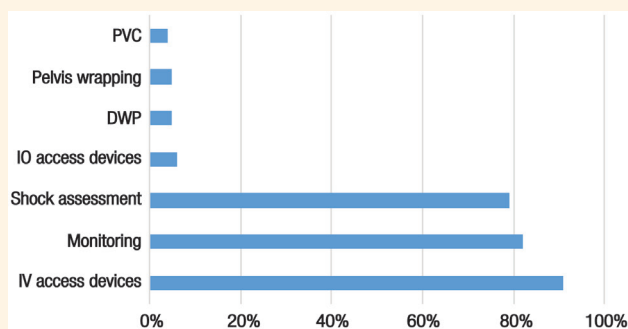


Figure 3: Frequency of consistent knowledge of circulation management and other trauma management procedures among doctors working at primary health centres in Seeb, Muscat, Oman (N = 80).

PVC = peripheral venous cutdown; DWP = deep wound packing; IO = intraosseous; IV = intravenous.

how to monitor changes in GCS and 25% did not know how to perform a surgical thoracotomy or undertake surgical neck exploration.

Overall, 73 doctors (91%) were involved in the management of trauma cases; however, there was no specialised trauma registry or database for them to record the details or handling of these cases. Moreover, 80% and 84% reported that their health centres did not have local trauma guidelines or manuals, respectively. Finally, 72 participants (90%) reported that there were no trauma committees, trauma simulation activities, trauma rooms or alarm criteria in the health centres where they worked.

Discussion

In most healthcare systems worldwide, trauma centres are designated at different levels according to their capacity to treat critically injured patients, with level I centres typically being considered most capable and level III centres being least capable.⁹ Generally, higher-level trauma centres provide the greatest level of care and have access to specialised trauma surgeons (i.e. neurosurgeons and orthopaedic surgeons) and nurses as well as trauma-specific diagnostic equipment.

In contrast, lower-level centres may only be able to provide limited initial care for patients with traumatic injuries (i.e. stabilisation), before arranging for the cases to be transferred to higher levels of care.⁹

According to the findings of the current study, the availability of physical resources for basic airway management was fairly good at the primary care level in Oman, with none of the eight primary health centres reporting major deficiencies in advanced airway and breathing devices. Similarly, the availability of intravenous access devices was adequate. However, most centres lacked the equipment needed for intraosseous and venous surgical access. In Oman, primary care generalists usually undertake the initial assessment of trauma cases and then, if the necessary equipment for management is unavailable, transfer them to the nearest hospital or trauma centre for stabilisation. In fact, the medical officers and nurses in-charge at centres in which intraosseous access devices were available admitted that this was because they had needed these devices in the past. This indicates that this type of equipment can be supplied to primary care centres if requested.

While basic laboratory equipment such as haemoglobin tests were available at the primary health

centres, electrolyte assays were not; in addition, all of the health centres lacked the physical resources and supplies necessary to perform blood transfusions. Moreover, while ECG machines were available in all health centres, they were deemed inadequate because of frequent malfunctioning. Plain radiography machines were present and widely used at all of the health centres, although there were some complaints that the equipment was non-portable. However, while ultrasonography facilities were available, this technology was not used for trauma investigation purposes. In addition, despite the presence of diagnostic equipment, such resources were considered either only partially adequate or inadequate by the respondents. As such, additional training of physicians regarding the use of radiological investigations and prioritising the maintenance of existing equipment to avoid frequent breakdowns would help reduce the number of referrals to trauma centres.

In Oman, primary care centres do not provide in-patient or specialised care and would, therefore, transfer trauma cases requiring such services to nearby hospitals or trauma centres. In addition, most members of the public are aware of the limited capabilities of care provided at primary centres and, in contrast, the availability of high-level services at trauma centres. Moreover, emergency medical services are often the first point-of-care for critically injured patients and would transfer such patients immediately by ambulance to a trauma centre.⁹ These factors might thus partly explain the lack of availability of certain types of equipment in primary health care centres. Nevertheless, in many trauma cases, immediate management can mean the difference between life or death.^{1,11} As such, it is important that necessary trauma equipment be provided to primary care centres for emergency situations in which timely transfer to a designated trauma centre is unfeasible or impossible.

In the present study, the majority of the primary care doctors surveyed demonstrated adequate knowledge and skills concerning airway and breathing management. As such, this finding indicates that related equipment can be supplied to the centres so that doctors can stabilise trauma cases before referring them to a tertiary hospital. However, in-service hands-on courses should be provided to all generalists and staff working at these centres to ensure that all practitioners hold the necessary knowledge and skills to correctly utilise these resources. In contrast, GPs or generalists in other countries are often not expected to perform specialised procedures such as endotracheal intubations. Moreover, certain procedures, such as intravenous access, pelvic wrapping, logrolling and

oxygen administration, would be performed by nurses more often. As such, further research should seek to determine the capabilities of nurses in trauma care in Oman.

Early definitive treatment is a major determinant of outcome in cases of severe trauma; as such, the method and time period in which the patient is transported to a medical facility is key.^{1,5,11} While Oman has had an emergency medical services (EMS) system in place since 2004, previous research indicates that it may be underutilised for a variety of reasons.^{12,13} A retrospective study by Al-Shaqsi *et al.* found that only 66.7% of RTC-related trauma cases over a one-year period were transported by ambulance.¹³ However, the analysis showed that while there was a 36% reduction in mortality with EMS-transported cases compared with those transported in private vehicles, this difference was not statistically significant ($P = 0.13$). The researchers also noted that the private transport of trauma patients was likely to continue and therefore recommended that members of the public undergo first aid training in order to reduce rates of related mortality and morbidity in Oman.¹³

A systematic review and meta-analysis carried out in North America reported a 15% reduction in mortality among severely injured patients treated in trauma centres following the establishment of a trauma system.¹¹ Within this type of system, a trauma registry with severity scoring is a key component of quality improvement, outcome evaluation and monitoring the process of care; moreover, trauma registries are invaluable during healthcare policymaking, auditing and resource allocation.^{9,14,15} At most of the studied health centres, there was no specific register or database for trauma cases, although there was one for referred cases which indirectly showed the number of cases referred to trauma centres. With appropriate organisation, planning and the allocation of resources, the authors believe that most primary health centres in Oman will be capable of delivering ETC services, thus reducing the burden on trauma centres and tertiary hospitals. Moreover, a set of national guidelines should be developed in order to standardise the provision of trauma care in Oman.

Education is of paramount importance to the success of a national trauma care system, not only on the part of formal healthcare practitioners such as physicians and nurses, but also for members of the public. The WHO guidelines for ETC highlight the importance of trauma training both during basic medical undergraduate and postgraduate education as well as via continuous education activities in order to update and maintain vital trauma-related knowledge and skills.⁵ Moreover, if provided with education

in basic life support (BLS), members of the public – including bystanders, family members or other nearby individuals with minimal medical training – can provide simple yet effective prehospital trauma care, thereby aiding the subsequent efforts of professional healthcare providers and potentially saving lives.¹⁶

This study was subject to certain limitations. While the study focused on physical resources, human resources and administrative functions related to ETC and outcome measures were not assessed. In addition, the study was only carried out in Muscat; as other regions of Oman were not included, the results cannot be generalised to a national level. Furthermore, the study focused primarily on doctors and did not include nurses. In Oman, nurses are not required to be certified in advanced cardiovascular life support or ATLS, with BLS certifications considered sufficient. Therefore, doctors take the lead in trauma cases most often. Therefore, further research is recommended to determine nurses' trauma capability in Oman as these individuals play an essential role in trauma care. Finally, data regarding the ETC skills and knowledge of the doctors working in primary care centres depended primarily on self-reported responses; this measure could be subjective and lead to participants overestimating or over-reporting their capabilities. As such, future quantitative and qualitative research to evaluate trauma care in Oman is necessary.

Conclusion

This study investigated the trauma care capabilities of eight primary health centres in Muscat. Although the centres had the basic facilities needed for trauma care, their capacity was limited and both, human and physical resources, were lacking. Several centres reported shortages of equipment (i.e. airway breathing devices) and many doctors lacked in-service training in trauma care. Moreover, all of the centres had inadequate physical and human resources for managing head, neck and chest injuries. These deficits should be rectified and certain administrative functions implemented including trauma registries, quality improvement programmes and in-service training for practitioners at all healthcare levels. The authors recommend that national standardised guidelines be developed in order to determine necessary improvements to the provision of trauma care in Oman.

AUTHORS' CONTRIBUTION

AB, ZB conceptualised and designed the study. AB and ZB collected the data. AB, ZB and AS analysed and interpreted the results. AB, ZB and AS drafted

the manuscript. All authors reviewed the results and approved the final version of the manuscript.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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