



Assessment of the availability of technology for trauma care in Nepal



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ABSTRACT

Background: We sought to assess the availability of technology-related equipment for trauma care in Nepal and to identify factors leading to optimal availability as well as deficiencies. We also sought to identify potential solutions addressing the deficits in terms of health systems management and product development.

Methods: Thirty-two items for large hospitals and sixteen items for small hospitals related to the technological aspect of trauma care were selected from the World Health Organization's *Guidelines for Essential Trauma Care* for the current study. Fifty-six small and 29 large hospitals were assessed for availability of these items in the study area. Site visits included direct inspection and interviews with administrative, clinical, and bioengineering staff.

Results: Deficiencies of many specific items were noted, including many that were inexpensive and which could have been easily supplied. Shortage of electricity was identified as a major infrastructural deficiency present in all parts of the country. Deficiencies of pulse oximetry and ventilators were observed in most hospitals, attributed in most part to frequent breakdowns and long downtimes because of lack of vendor-based service contracts or in-house maintenance staff. Sub-optimal oxygen supply was identified as a major and frequent deficiency contributing to disruption of services. All equipment was imported except for a small percent of suction machines and haemoglobinometers.

Conclusions: The study identified a range of items which were deficient and whose availability could be improved cost-effectively and sustainably by better planning and organisation. The electricity deficit has been dealt with successfully in a few hospitals via direct feeder lines and installation of solar panels; wider implementation of these methods would help solve a large portion of the technological deficiencies. From a health systems management view-point, strengthening procurement and stocking of low cost items especially in remote parts of the country is needed. From a product development view-point, there is a need for robust pulse-oximeters and ventilators that are lower cost and which have longer durability and less need for repairs. Increasing capabilities for local manufacture is another potential method to increase availability of a range of equipment and spare parts.

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Introduction

Worldwide over 5 million people die each year as a result of trauma [1]. Traumatic injuries are a rising cause of mortality especially in low- and middle-income countries (LMICs) [1–4]. In

Nepal a low-income country, trauma-related deaths account for 10% of the total mortality [5,6]. The age-standardised mortality rate for injuries in Nepal is 119 compared to the worldwide rate of 84 (per 100,000 population per year) [7,8]. It has been previously noted that this discrepancy in trauma deaths between LMICs and high-income countries is partly attributable to inadequacy of hospital and community-based emergency care [9].

In an attempt to reduce this disparity, the World Health Organization (WHO) published the *Guidelines for Essential Trauma Care* (EsTC) in 2004 [10]. This was done with intent to standardise

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the system of trauma care in every country regardless of the economic status. These guidelines include 260 human and physical resources required for the management of a victim of trauma. An important component of the physical resources is technology-related.

Many countries have been assessed under the EsTC guidelines, which has enabled the recognition of shortcomings and formulation of cost-effective recommendations to improve national trauma care systems [11–19]. In these prior evaluations, the factors responsible for the absence of trauma-related technological resources had not been explored in sufficient depth. We feel that this is an important contribution to complement the other more general EsTC studies. An evaluation of the availability of technology for trauma care has thus far been carried out only in India [20].

Building upon that prior study, the current study seeks to delve into greater depth to assess the factors influencing the availability of resources for the technology of trauma care in Nepal. In so doing, we have attempted to identify potential solutions to insufficiencies in two broad categories: health system management (e.g. procurement, stock management, financing) and product development (e.g. development of medical devices that are more durable and require less maintenance).

Methods

Site selection

Nepal has a per capita income of 694 USD and a population of 27 million and is classified as a low-income country [21,22]. The country is divided into administrative units called zones which are further divided into districts. Twelve out of the fourteen zones of Nepal were selected with an aim to cover the wide spectrum of geographic and economic diversity of the country. Districts have wide variations in their level of development and are ranked according to the Overall Composite Index of development [23]. The Overall Composite Index is a cumulative index of 29 indicators used to grade the development of the 75 districts. The 75 districts are divided into 3 developmental categories - high, medium and low development districts, with 25 districts in each. In an attempt to represent the diversity of the country, districts at all developmental levels were purposively selected to be studied [23].

The public healthcare delivery system includes a spectrum of facilities including: Sub Health Post (SHP), Health Post (HP), Health Centre (HC), Primary Health Care Centre (PHC-C), District Hospitals, Zonal Hospitals, Central and Regional Hospitals, medical colleges and teaching hospitals with residency programs, public health & medical institutes and other specialist hospitals [24]. The basic level of healthcare is delivered via clinics, which tend to have only one doctor and provide only out-patient requirements and provide no or very preliminary in-patient care. There is no formal referral system in place in Nepal and patients with serious injury (and also other serious illnesses) typically are brought to the nearest hospital level, bypassing the primary health care clinics, which are primarily for outpatient care and preventive health services. [25] As the trauma care provided by these facilities is of an extremely basic technological level, these facilities were not surveyed in this study. Small hospitals in Nepal have a capacity of 30–100 beds and were assessed in the study. These hospitals are uniformly managed and controlled by the Nepal government and hence, vary only on the basis of geographical and developmental factors. Large hospitals having a bed capacity of 100–1000 beds were also surveyed for this study. These hospitals not only varied based on geographical and developmental factors as the small hospitals, but also according to the regulations imposed upon them

by the Nepal Medical Council for medical school and residency program licensures [26].

For this study, a total of 56 small hospitals and 29 large hospitals were purposively selected out of a total of about 74 small hospitals and 55 large hospitals countrywide, to represent the diversity of trauma care development, geography and local socioeconomics. [24]. Only facilities which were government-operated or government-affiliated were evaluated because they provide the majority of trauma care in the country, in the expert opinion of the two authors (SB, NL) who are trauma care clinicians in Nepal.

Criteria for evaluation

In this study, the “essential” and “desirable” resources described in the *Guidelines for Essential Trauma Care*, were evaluated together. Essential items are those that are particularly inexpensive and cost-effective and should always be available for optimal trauma care, irrespective of the economic status. The desirable items are those which add extra value, but are not as cost-effective as the essential items [10].

Out of all these resources, the technology-related items were shortlisted and evaluated in every facility. The form used to survey small hospitals had 16 items listed and the form used for large hospitals had 32 items. They included equipment used for both diagnosis and treatment.

Site visit process

Interviews were conducted by two of the authors (S.B., N.L.) with key staff at each hospital. These included hospital directors; heads of departments of surgery, orthopedics, and other relevant specialties; emergency department (ED) head; nursing matron/head; and clinicians (doctors and nurses) on duty in the ED, intensive care unit (ICU), operating rooms (OR) and wards; and biomedical engineers and maintenance staff. Direct assessment of amenities and equipment in ORs, EDs, ICUs and wards were carried out. Direct inspection included visually determining presence or absence, examining equipment for functionality (e.g. assessing whether the item worked, was not missing components/reagents, was not prohibitively expensive for patients) and in cases of deficiencies, assessing why it was not rated 3 (e.g. stock management, training deficiencies, breakdowns). Factors contributing to proper availability were also recorded. Open ended questions were also asked to allow a more comprehensive assessment of the issues faced by the hospitals. The duration of the visits was around 4 h in clinics and small hospitals and 10 h at large hospitals. Each of the resources was assessed as:

Absent: 0.

Inadequate: 1 Less than half of those who need this service receive it when required.

Partly adequate: 2 Most, but not all, of those who need this service receive it when needed.

Adequate: 3 Virtually all of those who need this service receive it when needed.

Resources were evaluated based on their timely availability for those in need, and not just their mere physical presence. For each item recorded as 0–2, reasons for lack of full-time availability were given, including one or more of: not present, lack of reagents, lack of trained staff, awaiting repairs, need for prepayment and others. When differing scores were given by different respondents, an average/consensus value was recorded. One score for each institution for each category was thus derived. Names of respondents were not recorded. The study was approved by the

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