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# Prioritizing injury care: a review of trauma capacity in low and middle-income countries



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## ABSTRACT

**Background:** Trauma is a large contributor to the global burden of disease, particularly in low and middle-income countries (LMICs). This study aimed to summarize the literature assessing surgical capacity in LMICs to provide a current assessment of trauma capacity, which will help guide future efforts.

**Materials and methods:** The MEDLINE database was queried via PubMed to identify studies assessing baseline surgical capacity in individual LMICs. Data were collected from each study by extracting the relevant information from the full-published text or tables. Trauma capacity was evaluated using 12 surrogate criteria of trauma care, including laparotomy, cricothyroidotomy and chest tube insertion capabilities, and accessibility to a blood bank. **Results:** Seventeen studies were reviewed, documenting data from 531 hospitals in seventeen countries. None of the countries had access to all twelve trauma criteria in all their hospitals. Endotracheal intubation and cricothyrotomy or tracheostomy were available at 48% (107/222) and 41% (163/418) of facilities, respectively. Bag mask valves were available at 61% (234/383) of the institutions. Although 87% (193/221) of facilities responded that they were able to provide initial resuscitation, only 48% (169/349) of them had access to a blood bank and 70% (191/271) had access to intravenous fluids. A third or less of district hospitals had access to basic resuscitation (33%; 8/24), endotracheal tubes (32%; 31/97), blood banks (31%; 32/102), and cricothyrotomies and/or tracheostomies (32%; 30/95).

**Conclusions:** Deficiencies in trauma capacity in LMICs remain widespread. This study provides specific avenues for improved evaluations of trauma capacity and for strengthening trauma systems in LMICs.

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## 1. Introduction

Trauma is a large contributor to the global burden of disease and now a leading cause of death and disability, particularly in low

and middle-income countries (LMICs). In fact, 90% of the world's trauma deaths occur in LMICs. Moreover, injury-related deaths, particularly violence and war-related, as well as self inflicted and road traffic injuries are expected to rise significantly until 2020 [1].

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Efforts have been made to augment the capacity to provide trauma care in LMICs. In 2004, the World Health Organization (WHO) issued guidelines for essential trauma care [2], which provided a framework for assessing and improving trauma care in these settings. These guidelines have been implemented in a number of countries, and studies have shown some benefit in terms of trauma capacity [3–7].

More recently, a growing body of literature assessing surgical capacity in LMICs is becoming available, using the WHO's tool for situational analysis to assess emergency and essential surgical care (TSAAEESC) [8] and the personnel, infrastructure, procedures, equipment, and supplies (PIPES) index developed by Surgeons Overseas [9]. These survey tools represent snapshots of workforce and hospital-based resources required to provide surgical care; as hospital-based trauma care inevitably relies on a subset of these resources, these assessments also provide information on components required for adequate trauma care. This study aimed to summarize the literature using these tools to provide a current assessment of trauma capacity, which will help guide future capacity-building efforts.

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## 2. Material and methods

### 2.1. Data sources and study selection

The MEDLINE database was queried via PubMed to identify studies assessing baseline surgical capacity in individual LMICs. All studies from inception to July 2013 were included. References from included studies were also examined for any further articles that were missed. When multiple studies assessing surgical capacity for a given country were available, only the study including the largest number of facilities was included to avoid duplicate data. The remaining studies were excluded. Any disagreements were adjudicated through discussion amongst the authors.

### 2.2. Data extraction and synthesis

By group consensus, twelve criteria from those included in both the TSAAEESC and PIPES were included as surrogates of trauma care capacity. These included basic resuscitation; pulse oximeter; fluids; endotracheal tube; bag mask valve; blood bank; chest tube; laparotomy; closed fracture reduction; open fracture repair; cricothyrotomy and/or tracheostomy; and amputation. The availability of a given item was scored on a binary system; if a criterion was always available, one point was accorded, whereas none were given otherwise. Because the TSAAEESC is rated on a more complex scale, a point was only attributed if the given criterion was always available (1) to have comparable scales between PIPES and TSAAEESC and (2) because we believe we should strive to always have these criteria available. Data were collected from each study by extracting the relevant information from the full-published text, tables, or graphs. When data for a given criterion were not available, facilities in that study were excluded and a new denominator was calculated. If a reviewed article did not provide any information on the chosen criteria, the article was excluded. When only percentages were offered, the absolute

number of corresponding facilities was calculated. For the studies in which the data were reported as a range, the mid-range was calculated and used. All data were then aggregated into a single file and analyzed with descriptive statistics.

Initially, results were globally compared across countries. To gain a further understanding of the distribution of resources within trauma systems, the availability of items were further categorized, when defined in the original article, into levels of health care facility as follows: primary and/or district, secondary and/or provincial, and tertiary and/or regional. Mission hospitals and nongovernmental hospitals were included in the tertiary and/or regional category. For this subanalysis, articles that did not provide a breakdown of resources according to facility level were excluded.

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## 3. Results

Seventeen studies were identified, documenting data from 531 hospitals in 17 LMICs (Table 1). These countries spanned five continents: Africa (10); Asia (4); North and Central America (1); South America (1); and Oceania (1). The number of facilities per country ranged from 9 in the Solomon Islands to 103 in Zambia. None of the countries had access to all twelve trauma criteria in all their hospitals.

Airway management criteria were least prevalent. Overall, endotracheal intubation and cricothyrotomy or tracheostomy were available at 48% (107/222) and 41% (163/418) of facilities, respectively. In Ghana, endotracheal intubation was available at 18% (3/17) of surveyed hospitals, whereas Uganda fared better, with 79% (22/28) of facilities able to provide intubation. More advanced airway techniques, including cricothyrotomy and tracheostomy, were also limited in Ghana (12%; 2/17), although they were least available in Sri Lanka (5%; 1/20).

Overall, bag mask valves were available at 61% (234/383) of institutions, whereas pulse oximeters were available at 52% (185/357) of hospitals. Only 9% (4/44) of facilities in Mongolia had access to bag mask valves, in contrast to the Solomon Islands, where these masks were always available in 100% (9/9) of hospitals.

Although 87% (193/221) of facilities responded that they were able to provide initial resuscitation, only 48% (169/349) of them had access to a blood bank and 70% (191/271) had access to intravenous fluids. Specifically in Ghana, 6% (1/17) of facilities were able to provide basic resuscitation. Although all hospitals surveyed in Afghanistan and Bolivia claimed to have the capabilities to provide basic resuscitation, only 65% (11/17) and 32% (10/31) had access to a blood bank, respectively. Less than a quarter (23%; 10/44) of facilities surveyed in Mongolia had access to a blood bank, whereas all hospitals (100%; 20/20) in Ethiopia could provide transfusions.

Chest tube insertion capabilities were always available at 65% (247/378) of facilities. Although 90% (93/103) of surveyed facilities in Zambia offered chest tube capabilities, this was only available in 32% (14/44) of hospitals in Rwanda.

In terms of definitive management, 70% (271/385) of hospitals had the capacity to perform a laparotomy. For orthopedic injuries, 51% (159/314) and 75% (242/323) of facilities were able to perform an open fracture repair and closed fracture reduction, respectively. None (0%; 0/31) of the

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