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Injury

journal homepage: www.elsevier.com/locate/injury

Development of a novel Global Trauma System Evaluation Tool and initial results of implementation in the Republic of South Sudan



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ARTICLE INFO

Article history:

Accepted 3 August 2014

Keywords:

Trauma systems
Global surgery
Global injury
International surgery
Injury care

ABSTRACT

Introduction: Trauma remains a leading cause of death and disability in the world, and trauma systems decrease mortality from trauma. We developed the *Global Trauma System Evaluation Tool (G-TSET)* specifically for use in low- and middle-income countries (LMICs). The Sudan People's Liberation Army (SPLA) in the Republic of South Sudan (RSS) desires a military trauma system (MTS) which allowed us to pilot the G-TSET.

Methods: The G-TSET was developed by modifying key components of a trauma system applicable to LMICs. We partnered with the SPLA Medical Corps using clinical collaboration, direct observation, and discussion groups. Benchmarks and indicators were scored with 5 indicating "full capability" and 1 meaning "not present" and were used to develop a SPLA MTS plan.

Results: The overall MTS score was 1.15 indicating an urgent need for system development. The assessment highlighted the need for SPLA Command support. Battlefield care, transport to a trauma

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<http://dx.doi.org/10.1016/j.injury.2014.08.004>

0020-1383/Published by Elsevier Ltd.

facility, and inter-facility communication were identified for improvement. After essential battlefield care, consisting primarily of bandaging and splinting, transport times for injured SPLA soldiers were 12 h to 3 days by truck. Based on our findings, we collaborated with SPLA medical leadership to develop a plan to develop a formal MTS.

Conclusion: We piloted a novel trauma system assessment tool for the MTS in the RSS. Qualitatively, we identified gaps in the MTS and provided the medical leadership with a plan for improvement. We anticipate a short-term follow-up to quantify improvement, and we seek to validate this tool for use in other countries.

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Introduction

Trauma remains a leading cause of death and disability in the world and disproportionately affects low to middle income countries (LMICs), with 90% of the injury-related deaths occurring in these settings [1]. Additionally, global statistics show that injuries account for nearly 10% of all deaths worldwide [2]. Deaths from serious injury are twice as high in low-income countries without a trauma system when compared to high-income countries with trauma systems (35% versus 63%, respectively in one study) [3]. The medical literature consistently shows that a well-organized system of care for an injured person decreases mortality from injury by 15–20% [4–7]. Compelling evidence suggests that functional trauma care systems in low-income countries could save millions of lives each year throughout the world [8]. Currently, no formal method exists to evaluate trauma systems in low-resource settings. Efforts to improve existing and developing trauma systems must be based on assessments conducted to identify key capability gaps and guide development.

The Republic of South Sudan (RSS) gained independence in 2011 after more than 40 years of civil war causing more than 2 million deaths and the displacement of more than 4 million people [9]. The disruption in essential services, including healthcare, is widespread. Patient-focused essential surgery and injury care aims to return those with disabling surgical disease and injury to a functional role in society. Initiation of such changes might allow individuals to provide for themselves and their families. On the national socioeconomic level, it returns capable people to the labour force saving money otherwise spent to care for chronic surgical disease. Previous studies have shown poor surgical capacity in South Sudan [10] and emphasized the benefits of involving local healthcare workers and leadership in any activity designed to improve their healthcare system [11].

Sudan People's Liberation Army (SPLA) is the military arm of the Republic of South Sudan (RSS). The SPLA Medical Corps is responsible for the care of their injured soldiers beginning on the battlefield at the point of injury (POI) through definitive care and rehabilitation. In addition to caring for military patients, the Juba Military Hospital is a national trauma referral centre, and it provides a large portion of the nation's civilian trauma care. The recent unrest in South Sudan which began in December 2013 [12] highlights the need for the SPLA military to further develop its trauma care system.

We developed a novel Global Trauma System Evaluation Tool (G-TSET). The purpose of the G-TSET was: (1) to perform trauma systems assessments in a variety of low-resource settings and (2) to serve as a framework for "nation-centred development" based on identified gaps. The SPLA Medical Corps is in the process of developing a military trauma system (MTS) to leverage the advantages of improving outcomes for victims of trauma in the RSS. At their request, we piloted the G-TSET in the RSS.

Methods

The Systems of Trauma Evaluation, Assessment, and Research (STEAR) Working Group was established to develop and implement the G-TSET. This international group united the knowledge, skills and experience of eleven military and civilian trauma surgeons, physicians, nurses, epidemiologists, and personnel with military experience to develop a trauma system assessment tool that could be applied globally in LMICs. Members of the STEAR working group met virtually and in person. Individuals provided feedback regarding the content of the G-TSET through small group discussion or via email, and the tool was then revised. This iterative revision process continued over an approximately three month period until all members were satisfied with its content. In addition, prior to piloting this tool, two individuals from RSS reviewed the G-TSET for face validity and accepted it for application in their country.

The Global Trauma System Evaluation Tool (G-TSET) was developed by identifying and modifying key elements of developed trauma systems applicable to low-resource settings. The American College of Surgeons Committee on Trauma *Resources for the Optimal Care of the Injured Patient* [13] and *Regional Trauma Systems: Optimal Elements, Integration, and Assessment Systems Consultation Guide* [14], along with the US Department of Health and Human Services *Model Trauma System Planning and Evaluation* [15] guide and tool were used to create the bulk of the G-TSET. Specifically, information regarding the application of the public health model to trauma systems development in regards to assessment, analyzing changes, and outcomes were adapted for creation of our tool and its implementation in the RSS. The concepts of designating lead agencies, identifying and gaining buy-in from key stakeholders, and creating written trauma system plans were adapted to a LMIC setting. The use of benchmarks, indicators, and scoring for each trauma system component was derived from *Model Trauma System Planning and Evaluation* [15]. Some of these same component indicators and benchmarks were used in the G-TSET, but others were created based on the STEAR working group's knowledge and prior experience in LMICs as well. Other references [16–19] were pre-hospital and in-hospital checklists taken from pre-existing World Health Organization (WHO) tools. There are nested references within our trauma system tool to ensure continuity with these existing WHO efforts. See Supplemental Digital Content (SDC) 1 – Global Trauma System Evaluation Tool and SDC 2 – G-TSET Embedded WHO Checklists.

The essential components of a trauma system adapted for the G-TSET included: *System Leadership, Access to Care, Initial Resuscitative Care, Acute Injury Care, Rehabilitation, Prevention, and Education/Research/Quality Improvement (ERQI)* Within the tool, each trauma system component is supported by benchmarks and indicators that determine satisfactory compliance with all aspects of that component. Indicators are scored on an ordinal scale, ranging from "no capability" to "full capability" based on whether that indicator is fully present or present to lesser extents,

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