Title

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Journal

Injury Extra, 49(11)

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Publication Date

2018-11-01

DOI

10.1016/j.injury.2018.08.013

Peer reviewed

HHS Public Access

Author manuscript

Injury. Author manuscript; available in PMC 2019 November 01.

Published in final edited form as:

Injury. 2018 November ; 49(11): 1969–1978. doi:10.1016/j.injury.2018.08.013.

Utilization of injury care case studies: a systematic review of the World Health Organization's "Strengthening care for the injured: Success stories and lessons learned from around the world"

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Abstract

Objective.—Translation of evidence to practice is a public health priority. Worldwide, injury is a leading cause of morbidity and mortality. Case study publications are common and provide potentially reproducible examples of successful interventions in healthcare from the patient to systems level. However, data on how well case study publications are utilized are limited. To our knowledge, the World Health Organization (WHO) published the only collection of international case studies on injury care at the policy level. We aimed to determine the degree to which these injury care case studies have been translated to practice and to identify opportunities for enhancement of the evidence-to-practice pathway for injury care case studies overall.

Methods.—We conducted a systematic review across 19 databases by searching for the title, "Strengthening care for the injured: Success stories and lessons learned from around the world." Data synthesis included realist narrative methods and two authors independently reviewed articles for injury topics, reference details, and extent of utilization.

Findings.—Forty-seven publications referenced the compilation of case studies, 20 of which included further descriptions of one or more of the specific cases and underwent narrative review. The most common category utilized was hospital-based care (15 publications), with the example of Thailand's quality improvement (QI) programme (10 publications) being the most commonly cited case. Also frequently cited were case studies on prehospital care (10 publications). There was infrequent utilization of case studies on rehabilitation (3 publications) and trauma systems (2 publications). No reference described a case translated to a new scenario.

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Conclusions.—The only available collection of policy-level injury care case studies has been utilized to a moderate extent however we found no evidence of case study translation to a new circumstance. QI programmes seem especially amenable for knowledge-sharing through case studies. Prehospital care also showed promise. Greater emphasis on rehabilitation and health policy related to trauma systems is warranted. There is also a need for greater methodologic rigor in evaluation of the use of case study collections in general.

Keywords

Case studies; global injury care; global trauma; trauma quality improvement; prehospital care; realist review

INTRODUCTION

Injury is a leading cause of global morbidity and mortality. Each year, over 900 million individuals are injured and 5 million people die, a figure nearly double the annual mortality of HIV, tuberculosis and malaria combined[1,2]. An estimated 90% of injuries occur in low- and middle-income countries (LMICs) where injured patients are six times more likely to die than those in high-income countries[1,2]. Many of these deaths could be prevented and result from poor access to quality trauma care including timely surgical intervention[3].

Translation of evidence-to-practice is a public health priority and known to be slow, often delayed up to 17 years in developed health systems[4,5]. Data suggest that patients in the United States receive just over one-half of recommended processes in medical care[6]. This combination of time lag and low penetrance of evidence is problematic, especially in public health crises[7]. Efforts to translate evidence-to-practice for those caring for the injured face the challenge of knowledge-sharing globally constrained by unequal access to scientific literature, disparities in health systems, language barriers, and over-extended providers in low-resource settings. Educational efforts towards knowledge-sharing that involve descriptions of individual successes as example cases for others to replicate are efficient, easily digestible, and increasingly common in higher education, government, and non-governmental organizations[8–10]. The World Health Organization (WHO) is one such organization invested in capacity building through knowledge-sharing and often utilizes case studies as part of those endeavors [11,12].

Given the global burden of injury, WHO published three sets of trauma care guidelines in an effort to synthesize trauma best practices[13–15]. Data suggest uptake of these guidelines has been substantial though room for additional implementation exists[16]. In addition to formal guidelines, the WHO also published a series of case studies on improving global injury care[17]. “Strengthening care for the injured: Success stories and lessons learned from around the world” (SCFTI) gives detailed accounts of cases from 13 countries that cover the spectrum of injury topics including prehospital care, hospital-based care, rehabilitation, and system-wide improvements. The text provides concise descriptions of successful policies used to improve injury care in countries from multiple regions and all economic levels.

To our knowledge, this is the only example of a case study collection on injury care focused globally at the policy level (as opposed to direct clinical care). We sought to understand if

and how this collection of case studies assembled by the WHO has been utilized since publication as a gauge of the overall utility of injury case studies. We also sought to identify which specific cases and injury care topics were most amenable to dissemination through this case study medium. More broadly, we sought to identify potential strategies for improving the utilization and implementation of lessons learned from case studies in general. By evaluating the current use of injury case studies we hope to contribute evidence to the discussions on efficient strategies towards closing knowledge gaps, sharing innovative practices, and supporting overall improvements in global injury care.

METHODS

Study Design

We conducted a systematic review (PROSPERO CRD42017078259) to determine if efforts aimed at improving care for the injured use the example cases described in SCFTI. A systematic review was chosen to broadly answer the questions of who used this book, where it was used, which example cases were most useful, how the case studies informed efforts to improve care for the injured, and how these experiences were disseminated in the literature. Additionally, we incorporated elements of realist synthesis in a narrative review of the articles. Realist synthesis (or realist review) is an emerging study design that may have particular relevance in public health interventions and implementation science as compared to more traditional systematic reviews[18]. This method emphasizes context and descriptive strategies to explain reasons behind a particular outcome[19]. A realist review approach was an ideal methodology for the narrative review in this circumstance because the adoption of new initiatives, the transmission of ideas through published literature, and the role that example cases might play in idea development may be heterogeneous and situation dependent. We adhered to the RAMESES (Realist And MEta-narrative Evidence Synthesis: Evolving Standards) guidelines to ensure scientific rigor in conducting this review[19].

Literature Search

We searched 19 databases including PubMed (MEDLINE), Embase, Scopus, Web of Science, Google Scholar, CINAHL, Cochrane, Global Health – CABI/Archive, Global Health Medicus, SciELO, Proquest Dissertation and Thesis, Grey Literature Report, OAIster, COS Conference Papers Index, WHO International Clinical Trials Registry Platform Search Portal, Google, WorldCat, and Open-Grey. We used the title ("Strengthening Care for the injured: Success stories and lessons learned from around the world") as the search term in all databases. Although SCFTI is only available in English, we did not limit article inclusion by language. The literature search was conducted between May and September of 2017.

Selection and Appraisal of Documents

After removing duplicates, all items returned from the electronic search were examined for mention and/or reference to SCFTI. We included all works that cited SCFTI and also were available to read in entirety (via website or downloadable format). All articles that mentioned or referenced SCFTI were included for analysis and those that did not were excluded. Next, in order to screen for articles with more detailed case descriptions and

potential for translational content, we categorized each article using a dichotomous variable based on the level of detail provided by the authors (any details/no details). Articles with no details on SCFTI were excluded from further narrative analysis. For example, if authors referenced SCFTI in a general statement about global injury burden, but no additional description was provided, the item was categorized as not containing a detailed description related to SCFTI but still counted in the review. Mentioning a specific case study in SCFTI, such as hospital care in Qatar or the implementation of the trauma quality improvement program in Thailand, underwent further narrative analysis (see below). We extracted the following data from all items: 1) article type (research article, book chapter, policy paper, review article, or education document); 2) injury topics (road safety, trauma systems, quality improvement, regionalization of trauma care, prehospital care, trauma registry, rehabilitation services, and governance); 3) language. Injury topic categories included themes noted in the section headings of SCFTI (prehospital, hospital-based, rehabilitation, and system-wide). Additional themes were developed during initial document review to include known focuses in the area of trauma literature (road traffic safety, regionalization, etc.). The values in each categorical variable were iterative and additions were made if we encountered topics not represented in the original list. Counts and proportions for non-overlapping comparisons were generated for categorical variables where appropriate.

Narrative Analysis

Items meeting criteria for the narrative analysis were reviewed using realist synthesis methods and according to four domains (Table 1). These domains were developed to systematically answer the question: have the lessons learned documented in SCFTI been subsequently adopted in other circumstances? We addressed this question rigorously for each article taking into consideration the type of article, stated aims of the authors, the context of the citation, and the key features of the case being referenced. Two reviewers independently evaluated each publication in the narrative analysis according to the matrix in Table 1 blinded to the other's results. Disputes were resolved through discussion between reviewers.

All publications were stored in Zotero citation manager, data were extracted directly into Microsoft Office Excel (Microsoft Corporation, Redmond, WA) and all quantitative analyses were performed in Stata 14.2 (StataCorp, College Station, TX).

RESULTS

Quantitative Search Results

Our search identified 156 articles using the search term "Strengthening care for the injured: Success stories and lessons learned from around the world." Of those 156 articles, 91 were unique citations and 14 were excluded due to being published before 2010 (year of WHO publication of SCFTI) (Figure 1). Of the 77 articles reviewed, 30 did not contain a reference to the WHO book. The complete list of references is shown in Table 2. Among the 47 publications analyzed, 20 included a specific reference to a location, case, or topic and underwent further examination in the narrative review. Forty-five (96%) of the publications were written in English, one in Farsi, and one in Portuguese. Thirty-three (70%) of 47

articles cited SCFTI in reference to at least one focused injury topic, and an additional 13 articles included a second topic (Table 3). The most prevalent topics covered were trauma systems (34%) and prehospital care (21%). The next most common topics were road safety and trauma quality improvement covered in 11 (23%) articles. Nearly 62% (29 of 47) of articles citing SCFTI were research articles. Our search also returned five (11%) editorial pieces, five (11%) book chapters, four (9%) policy documents, and four (9%) review articles.

Narrative Review Results

Twenty publications met criteria for the narrative review. Fourteen were research articles, three were textbook chapters, and three were WHO reports. Within these publications, the case example from Thailand was referenced 10 times, with the next most common case studies being Ghana (4), Colombia and Romania (4), and Vietnam (4) (Table 4). Content within each article was analyzed according to our specific matrix (Table 5). None of the publications described an example where a case from SCFTI translated into a specific new action. However, most (15 of 20) provided a detailed description of the case and suggested, or implied, that the strategies employed in the case should be considered in subsequent initiatives with similar goals. Eight articles focused specifically on one country and the remaining twelve addressed injury regionally, among LMICs, or globally. There were three publications where achievements documented in one location were referenced by authors working in another: 1) the research article by Wesson[44] and colleagues on trauma systems in Kenya cited the legislation passed in Colombia; 2) the research article from Suriyawongpaisal[35] and colleagues on the impact of the Emergency Medical Institute of Thailand cited legislation passed in Romania and Colombia; 3) the research article by Hanche-Olsen[24] and colleagues on trauma care in Botswana cited quality improvement (QI) systems in Thailand.

In terms of injury care categories, the most frequently cited cases were those addressing hospital based issues. There were 15 such citations, with the Thailand QI case study being the single most frequently cited example. The second most common category was prehospital care, with 10 total citations. The third most common was trauma systems, with only 4 citations. However, several of the other categories did address similar systems issues, including the case study on Viet Nam, which evaluated care for a network of hospitals, and Colombia and Romania, which evaluated the effect of new policies for emergency medical services (EMS). The least frequently cited category was rehabilitation, with only two citations.

Narrative Findings for Commonly Cited Cases

Thailand (quality improvement programme).—The article by Fuangworawong[50] and colleagues utilized a survey on hospital quality improvement activities that overlapped substantially with features described in the Thailand case. Several articles cited the quality improvement program in Thailand as a prime example of piloting projects, data-driven quality programs, and administrative function[2,24,26].

Ghana (initiation of a new prehospital ambulance service).—Articles that mentioned Ghana most often related to topics focused in Ghana. Authors described the National Ambulance Service (NAS) as changing the landscape in pre-hospital care for the better, the unique circumstances that likely contributed to establishing the NAS, and potential opportunities for growth[53,58,64].

Colombia and Romania (nationwide legislation on EMS).—The cases from Colombia and Romania described national EMS legislation in Colombia and the creation of a national EMS government post in Romania. Both of these used the legislation process to address issues around gaps in prehospital care and fragmentation of prehospital services. For publications citing these examples, the authors pointed to the potential utility of legislation focused on trauma systems to address broad issues in injury care[23,29,35,44].

Viet Nam (improvements in injury care in network of hospitals in Hanoi).—The critical case elements of Viet Nam encompass a breadth of injury related topics and improvements that resulted from multidisciplinary collaboration between academia, the public sector and non-governmental organizations. Importantly, the Hanoi health department created policy around standards for infrastructure, equipment, training and staff development for injury care at health clinics and hospitals in Hanoi. Authors used the Viet Nam case in two book chapters, one review article, and one instance of published remarks on global injury as an example of comprehensive efforts to improve trauma capabilities[23,39,42,47]. These publications did not emphasize specific elements from the case.

DISCUSSION

This is the first attempt, to our knowledge, to evaluate the global utilization of a collection of injury care case studies in the published literature. Our results demonstrate moderate use of the single available collection of injury-focused case studies (SCFTI) in research articles, review articles, book chapters, and editorials. Trauma systems, prehospital care, road safety, and quality improvement were the most common injury topics contextualizing citations of SCFTI. Among articles that made specific reference to cases, the most common category was hospital-based care, with the case study on the QI programme in Thailand being the single most commonly cited case study. The next most commonly cited category was prehospital care, including the case studies from Cambodia/Iraq, Ghana, Mexico, and Colombia/Romania. While we did not discover an instance describing the translation of a success story from one circumstance to another, our results indicate broad utilization of case studies and the potential towards enhancing global injury care through harnessing lessons learned from published examples of success. Importantly, this discrepancy highlights the demand for this type of knowledge-sharing and the opportunity to better define the pathways from evidence-to-practice for injury care case studies.

The WHO recently published a systematic review of evidence evaluating the uptake of WHO trauma care guidelines[16]. This report measured implementation and dissemination of the WHO *Guidelines for essential trauma care* (GETC*), Guidelines for trauma quality improvement programmes* (GTQIP), and *Prehospital trauma care systems* (PTCS) and found GTQIP made up a minority of the results (12% of implementation, and 9% of dissemination,

respectively). This is the reverse from our findings where half the articles describing a case cited Thailand's example of quality improvement, not to mention that quality improvement was the third most common injury topic among all the articles reviewed. This may highlight attention to trauma quality improvement not captured by the prior study. As described in SCFTI, the establishment of a trauma registry at Khon Kaen Hospital in Thailand included staff and systems for data collection and analysis. Promoting data collection with adequate staff for maintenance and analysis aligns with known priorities for trauma and surgical care development in LMICs[42,65,66]. Specifically, the creation of a data collection infrastructure at a single institution may be more attainable than broader systems change and allow for easier identification of correctable quality issues, as was the case in Khon Kaen[17]. The attention to trauma quality improvement throughout Thailand has grown since publication of SCFTI[50]. The frequent citing of the Thailand case is an encouraging sign that individual institutions are focused on quality improvement, and that examples from individual case studies and the WHO GTQIP are resources for guidance on implementation[15].

Another commonly cited category of case studies was prehospital care. Ten of the 20 publications describing SCFTI referenced at least one of the cases focused on prehospital care. These cases describe examples of strengthening prehospital care in four general approaches: 1) training lay responders in areas without formal emergency medical services (EMS), 2) improvements through the establishment of EMS, 3) strengthening existing EMS, and 4) passing formal legislation to standardize and fortify EMS. Interest in prehospital care is well-documented and these four scenarios likely capture a wide range of applicable circumstances[14]. However, in locations around the world without prehospital emergency services, injury mortality is high and the case describing that specific scenario (Iraq/Cambodia) was referenced only one time. One possibility for this underuse is that details surrounding prehospital care cases are specific to those locations and the strategies to apply those lessons elsewhere may not be immediately obvious. For instance, the high frequency of landmine injuries in Iraq and Cambodia, the 2001 stadium disaster in Ghana leading to formation of the NAS, and the multiple layers of EMS providers in Mexico, create backdrops to those cases that may obscure the critical lessons for some potential users. Authors of future case studies may elect to include formal sections on key principles applicable in all situations, steps for translation into other circumstances, and how to know if a user's scenario applies well to a particular example.

The only cases in SCFTI to explicitly deal with trauma systems governance were from Sri Lanka and Canada and our search found only four publications that specifically described these cases. The Sri Lanka example describes the creation of a Trauma Secretariat to manage elements of the nationwide trauma system including legislation, clinical protocols, service development, and a national trauma registry[17]. The Canada example involved the formation of a Province-wide trauma system in Quebec[17]. For the Sri Lanka example, similar issues in the application of lessons learned to the particularities of other situations may explain why comparably few citations were present despite the broad acceptance that policy tools are critical components of improving trauma care globally[25].

Two cases from SFCTI (India and Brazil) focus on rehabilitation after injury[17]. Only two publications referenced these cases. Our findings underscore the known gaps in research and

resources focused on rehabilitation in LMICs[67]. Looking forward, greater emphasis on rehabilitation in trauma programs and research will be an important step towards improving care for the injured globally.

In the systematic review of WHO trauma care guidelines uptake, LaGrone and colleagues discuss the utility of a unified strategy for the dissemination and implementation of guidelines[16]. The WHO publishes a handbook for guideline development that includes sections on dissemination and implementation[68]. Unfortunately, no such resource exists for collections of case studies though case studies are used frequently by WHO and others across health disciplines and continents[11]. In addition to guidelines aimed at maximizing the utility of case studies, appropriate metrics are urgently needed to measure the utility and translation of case studies to practice. Infrastructure outside peer reviewed publications to capture when and how these cases are used may prove useful. Such an infrastructure would remove the barriers associated with peer-review publication often faced by users in low-resource settings and may generate a rich body of examples where individual case studies provided the roadmap to new successes in improving care for the injured.

This study has several limitations. Editors involved in SCFTI were listed as co-authors in 18 out of 47 of the captured results and may suggest an over-representation of overall use. When considering evidence-to-practice, potential barriers to translation include gaps between the research and policy communities[69]. The proportion of references listing SCFTI editors as co-authors may reflect an overlap between individuals in injury research and policy across global regions and country income levels and represent a fertile opportunity for developing and reinforcing evidence-to-practice pathways among this interwoven communtiy[69]. Also, the majority of authors in the results had no involvement in SCFTI suggesting broader acceptance overall. Our results did not capture a clear example of case replication as evidence of translation. However, knowing that on average this process can take up to 17 years, documentation of such direct implementation may yet be a ways off[4,5]. Also, identifying this gap is of critical importance if efforts to improve the utility of case studies are to be benchmarked in the future against previous evaluations. Given that systematic reviews evaluating a single publication of case studies are rare, we developed our own framework for a narrative review that has not been previously validated. Also, many stakeholders and potential users of SCFTI may have structural barriers to peer-reviewed publication making these results a potential underestimation of overall impact.

CONCLUSION

There is demand for case studies as a means to knowledge-sharing towards improving global injury care. This is especially true for case studies on trauma quality improvement among other injury topics. Minimizing the importance of case-specific details to promote translatable principles may be critical for future examples in prehospital care and trauma systems governance. Rehabilitation continues to be underrepresented in the trauma literature. The development of guidelines on writing, disseminating, and implementation of lessons learned from case studies, similar to other existing guidelines-for-guidelines, would be a useful tool for further injury-focused case studies, as well as for the use of case studies

more generally. Metrics for evidence-to-practice success pertaining to case studies are urgently needed.

Acknowledgements.

This study was funded in part by grant D43TW007267 from the Fogarty International Center, US National Institutes of Health, and T32 HD057822–08 from National Institutes of Child Health and Human Development. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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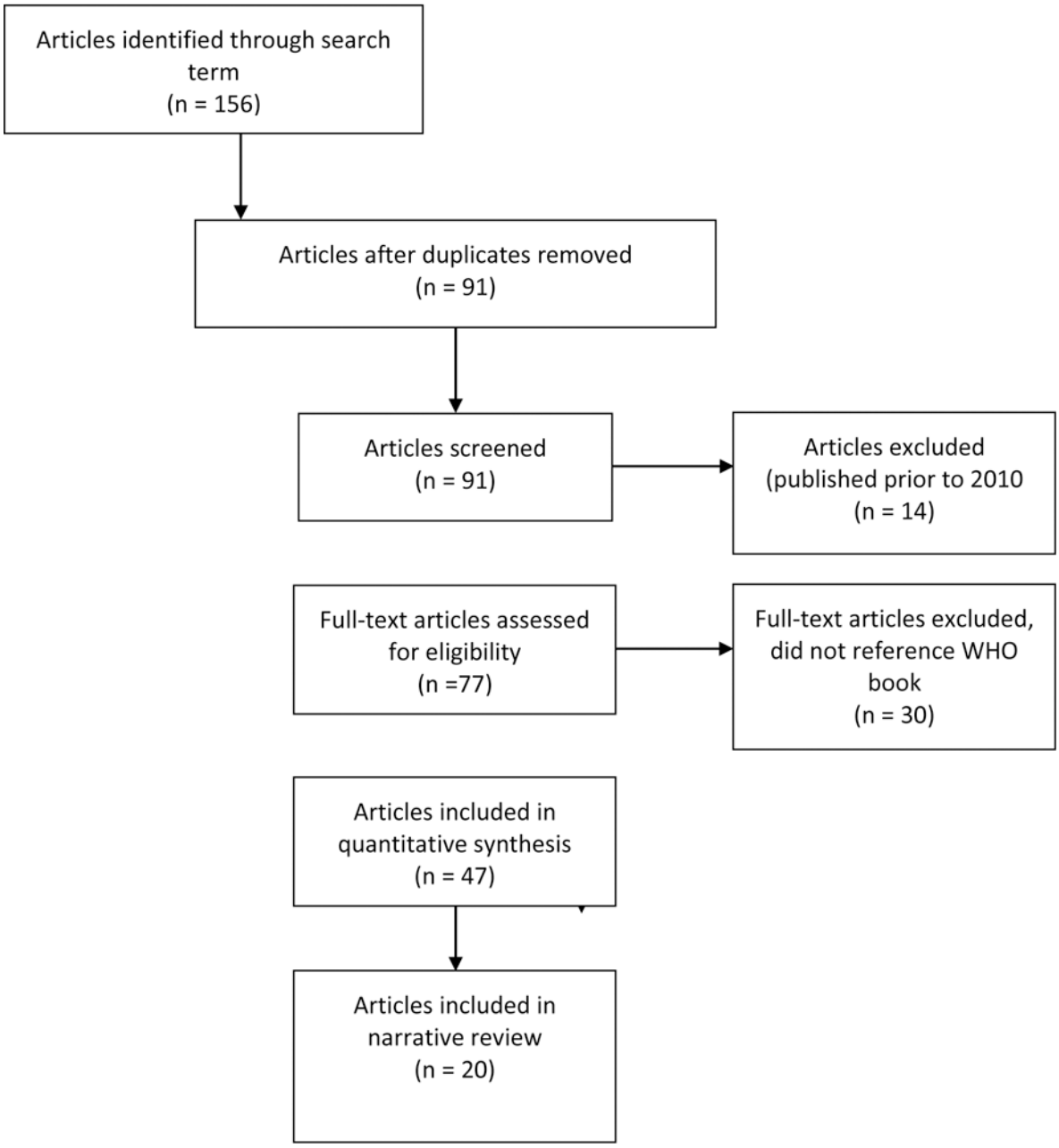

Figure 1.
Article Selection

Table 1.

Domains and Descriptions for the Narrative Analysis

Domain	Description	Example
1	What type of article is this and what are the stated aims?	Research article aiming to evaluate outcomes of intervention A in country B
2	What is the context and which case do the authors cite?	Cited in the introduction as background information in country C
3	When referring to a specific case, what were the key features of that case described in the book?	The success story in country D describes how interventions 1 , 2, and 3 led to lower trauma related deaths
4	Synthesize domains 1 through 3: given the type of article, stated aims by the authors, and context, were the lessons learned in the case translated to a new or potentially new circumstance?	Details were provided by the authors, however there was no evidence of translating lessons learned to new injury care environments

Table 2.

Articles referencing “Strengthening Care for the Injured: Success stories and lessons learned from around the world”

Author	Year	Title
World Health Organization[20]	2011	World Report on Disability
Haghparast-Bidgoli H et al.[21]	2011	Road Traffic Injuries in the Context of Rapid Motorization-Studies on Access,Provision and Utilization of Trauma Care in Iran
Sleet DA et al.[22]	2011	Injury prevention, violence prevention, and trauma care: Building the scientific base
Mock C[23]	2011	Strengthening care for the injured globally
Hanche-Olsen TP el al.[24]	2012	Trauma care in Africa: a status report from Botswana, guided by the World Health Organization’s “Guidelines for Essential Trauma Care.”
Anderson PD et al.[25]	2012	World Health Assembly Resolution 60.22 and Its Importance as a Health Care Policy Tool for Improving Emergency Care Access and Availability Globally
Stelfox HT et al.[26]	2012	Trauma Quality Improvement in Low and Middle Income Countries of the Asia–Pacific Region: A Mixed Methods Study
O’Reilly GM et al.[27]	2012	Global trauma registry mapping: a scoping review
Nielsen K et al.[28]	2012	Assessment of the status of prehospital care in 13 low-and middle-income countries
World Health Organization[29]	2013	Strengthening Road Safety Legislation a Practice and Resource Manual for Countries
Buchanan C[30]	2013	The health and human rights of survivors of gun violence: Charting a research and policy agenda
Vasconcelos PFNN[31]	2013	Promoção da qualidade dos cuidados de enfermagem à pessoa vítima de trauma grave
Rouhezamin MR et al.[32]	2013	The spatiotemporal pattern of trauma in victims of violence visited in emergency room of Rajaei Hospital, Shiraz, Iran
Haghparast-Bidgoli H et al.[33]	2013	Exploring the provision of hospital trauma care for road traffic injury victims in Iran: a qualitative approach
Buchanan C et al.[34]	2014	Surviving Gun Violence Project, eds. Gun Violence, Disability and Recovery
Suriyawongpaisal P et al.[35]	2014	A Thailand case study based on quantitative assessment: does a national lead agency make a difference in pre-hospital care development in middle income countries?
Yeboah D et al.[36]	2014	Minimizing preventable trauma deaths in a limited-resource setting: a test-case of a multidisciplinary panel review approach at the Komfo Anokye Teaching Hospital in Ghana
Al-Thani H et al.[37]	2014	Prehospital versus emergency room intubation of trauma patients in Qatar: a-2-year observational study
Stewart B et al.[2]	2014	Global disease burden of conditions requiring emergency surgery
Hanche-Olsen TP et al.[38]	2015	Evaluation of Training Program for Surgical Trauma Teams in Botswana
Browner BD et al.[39]	2015	Skeletal trauma: basic science, management, and reconstruction. Chapter 3: The Challenges of Orthopedic Trauma Care in the Developing World
World Health Organization[40]	2015	Global Status Report on Road Safety 2015
Rafiei N et al.[41]	2015	Epidemiology of injury in Aq-Qala city-Iran, 2007–2012
Debas HT et al.[42]	2015	Disease Control Priorities, Third Edition (Volume 1): Essential Surgery
Jabakhanji SB et al.[43]	2015	Agreements and practical experience of trauma care cooperation in Central Europe: The “Boundless Trauma Care Central Europe”(BTCCE) project
Wesson HK et al.[44]	2015	Trauma systems in Kenya: a qualitative analysis at the district level
Suriyawongpaisal P et al.[45]	2015	Does harmonization of payment mechanisms enhance equitable health outcomes in delivery of emergency medical services in Thailand?
Mock C[46]	2015	A banner year for global surgery: now how to make it make a difference on the ground

Author	Year	Title
Mock C[47]	2015	Essential surgery: key messages from Disease Control Priorities , 3rd edition
Rasmussen TE et al.[48]	2016	Rich's Vascular Trauma
Zakerimoghadam M et al.[49]	2016	The Effect of Trauma Intervention on the Satisfaction of Patients Admitted to the Emergency Department: A Clinical Trial Study
Fuangworawong P et al.[50]	2016	Assessment of trauma quality improvement activities at public hospitals in Thailand
Tansley G et al.[51]	2016	Population-level spatial access to prehospital care by the national ambulance service in Ghana
Stewart BT et al.[52]	2016	Road traffic and other unintentional injuries among travelers to developing countries.
Stewart BT et al.[53]	2016	Serial assessment of trauma care capacity in Ghana in 2004 and 2014
Stewart BT[54]	2016	Editorial Commentary on Bolkan et al."The Surgical Workforce and Surgical Provider Productivity in Sierra Leone: A Countrywide Inventory."
LaGrone LN et al.[16]	2016	Uptake of the World Health Organization's trauma care guidelines: a systematic review
Ahmed Z et al.[55]	2016	Renal Artery Injury Secondary to Blunt Abdominal Trauma – Two Case Reports
Peck G et al.[56]	2017	Latin America Indicator Research Coalition examines prehospital care using a trauma systems application of LCoGS indicator 1
Dicker R et al.[57]	2017	Trauma, Eigth Edition: Chapter 3 Injury Prevention
Zakariah A et al.[58]	2017	The Birth and Growth of the National Ambulance Service in Ghana
Landes M et al.[59]	2017	Epidemiology, clinical characteristics and outcomes of head injured patients in an Ethiopian emergency centre
Blair KJ et al.[60]	2017	Surgical and trauma care in low-and middle-income countries: a review of capacity assessments
Wesson HK et al.[61]	2017	Trauma care in India: A review of the literature
Reynolds TA et al.[62]	2017	The Impact of Trauma Care Systems in Low-and Middle-Income Countries
Blair KJ et al.[63]	2017	Assessment of Surgical and Trauma Capacity in Potosí, Bolivia

Table 3.

Injury topics covered by 47 articles citing the WHO's collection of case studies on trauma care[*].

Topic	Frequency
Trauma systems	16
Prehospital care	10
Road safety	8
Trauma quality improvement	9
Rehabilitation	2
Regionalization	1
Governance	1

[*] Strengthening care for the injured: success stories and lessons learned from around the world.

Table 4.

Case studies described in detail by 20 articles

Case	Frequency
Prehospital care	
Ghana	4
Colombia and Romania	4
Cambodia and Iraq	1
Mexico	1
Hospital-based care	
Thailand	10
Vietnam	4
Qatar	1
Rehabilitation	
Brazil	2
India	1
System-wide Improvements	
Sri Lanka	3
Canada	1

Total is greater than 20 as each article may cite one or more case studies.

Table 5.

Narrative Review Results for 20 articles that discuss individual case studies in detail.

Author(s)	Title	Year	Case(s)	Type of Article and Aims (Domain 1)	Context of Citation (Domain 2)	Synthesis (Domain 4*)
Mock, C.	Strengthening care for the injured globally	2011	Mexico, Cambodia/ Iraq, Thailand, Vietnam	Published remarks from invited lecture at national trauma meeting on injury as a global health issue	Examples of individual countries overcoming specific challenges	A
World Health Organization	World Report on Disability	2011	Brazil, India	WHO report detailing evidence for innovative policies and programs that improve the lives of people with disabilities and suggests next steps for stakeholders	Discusses rehabilitation services for spinal cord injury patients in Brazil and India	A
Stelfox, H. T et al.	Trauma quality improvement in low and middle income countries of the asia-pacific region: A mixed methods study	2012	Thailand	Mixed-methods research article detailing discussion content and survey results from a regional trauma QI meeting in Asia-Pacific region	Thailand case cited and described as an example of the importance of piloting projects	A
Hanche-Olsen et al	Trauma Care in Africa: A Status Report from Bostwana, Guided by the World Health Organization's "Guidelines for Essential Trauma Care"	2012	Thailand	Research article evaluating trauma care in Botswana	Thailand case referenced as an example of successful QI and the importance of functioning administrative functions	A
World Health Organization	Strengthening Road Safety Legislation a Practice and Resource Manual for Countries	2013	Colombia/R omania	WHO report describing methods and resources that practitioners and decision-makers can use for enacting laws or regulations in a comprehensive road safety strategy	Section 3.2.2 on ensuring a comprehensive regulatory and legislative framework for post-crash care	A
Al-Thani et al.	Prehospital versus emergency room intubation of trauma patients in qatar: A-2-year observational study	2014	Qatar	Research article evaluating outcomes comparing prehospital intubation vs ER intubation	Introductory remarks on prevalence of blunt trauma and advanced EMS services	B
Stewart, B et al.	Global disease burden of	2014	Thailand	Literature review of emergency	Discussion section refers	A

Author(s)	Title	Year	Case(s)	Type of Article and Aims (Domain 1)	Context of Citation (Domain 2)	Synthesis (Domain 4*)
	conditions requiring emergency surgery			general surgery (non-trauma, non-obstetric)conditions requiring surgery	specifically to Thailand case as an example of functioning QI in trauma and potential parallels to emergency general surgery	
Suriyawongpai sal, P et al.	A Thailand case study based on quantitative assessment: Does a national lead agency make a difference in pre-hospital care development in middle income countries?	2014	Colombia/R omania	Research article to assess the impact of the Emergency Medical Institute of Thailand (EMIT) reviewing pre-hospital care records over 4 years	When describing known barriers to systematic improvements for EMS in LMICs, authors cite the case from Colombia and Romania where legislation addressed these issues.	A
Wesson, H. K. H et al.	Trauma systems in Kenya: A qualitative analysis at the district level	2015	Colombia/Romania	Research article assessing perceptions of formal and informal district level trauma systems through interviews and focus group discussions in Kenya	The authors note the use of legislation as a tool towards enhancing prehospital care and cite the case in Colombia	A
Mock, C. N et al.	Essential surgery: Key messages from disease control priorities, 3rd edition	2015	Vietnam	Review article summarizing key findings from Volume 1 of Essential Surgery for the 3rd Edition of the Disease Control Priorities published by the World Bank	Refers to Vietnam case as an example of addressing problems related to the physical resources necessary to provide trauma care	A
Debas HT et al.	Disease Control Priorities, Third Edition (Volume 1): Essential Surgery	2015	Canada, Sri Lanka, Thailand, Vietnam	Book chapter on surgery and trauma in LMICs published by the World Bank	Section on trauma care systems describes in detail improvements in Quebec and Sri Lanka, and QI in Thailand	A
World Health Organization	Global Status Report on Road Safety, 2015	2015	Thailand	WHO report detailing the burden of road traffic injuries, examples of success, and areas for improvement	Thailand case cited as an example of trauma care improvement using QI	A
Browner BD et al.	Skeletal trauma: basic science, management,	2015	Thailand, Colombia, Vietnam, Sri Lanka	Textbook chapter on orthopedic injuries in the developing world	Section on improving system wide trauma care	A

Author(s)	Title	Year	Case(s)	Type of Article and Aims (Domain 1)	Context of Citation (Domain 2)	Synthesis (Domain 4*)
	and reconstruction. Chapter 3: The Challenges of Orthopedic Trauma Care in the Developing World				describes the Thailand case as an example of QI with results. Subsequent sections reference adherence to Guidelines to Essential Trauma Care and utility of needs assessments	
Fuangworawon g et al.	Assessment of trauma quality improvement activities at public hospitals in Thailand	2016	Thailand	Research article evaluating the presence of TQIPs and barriers to TQIP using a survey instrument at 110 trauma hospitals in Thailand	Discussion section contextualizing study results. Suggestion that Thailand could be a model for other nations implementing TQIPs	A
Japiong et al.	Availability of resources for emergency care at a second-level hospital in ghana: A mixed methods assessment	2016	Ghana	Research article evaluating the availability of resources at a second level hospital in Ghana	Introductory remarks highlighting focus in Ghana on prior initiatives not related to second-level hospitals	C
Stewart, B et al.	Serial assessment of trauma care capacity in Ghana in 2004 and 2014	2016	Ghana	Research article assessing changes in Ghana's trauma care capacity between 2004 and 2014	Cited book to reference the Ghana NAS as one of many examples for how the trauma landscape in Ghana has changed between 2004 and 2014	B
Tansley et al.	Population-level spatial access to prehospital care by the national ambulance service in Ghana	2016	Ghana	Research article to describe spatial access to formal pre-hospital care services in Ghana and identify ambulance stations for capacity expansion	Describes background information on the Ghana NAS	B
Reynolds, T. et al.	The impact of trauma care systems in low-and middle-income countries	2017	Brazil, Sri Lanka, Thailand	Systematic review aimed at synthesizing the impact of trauma care systems in LMICs	Resulted from search terms, 1 of 186 reviewed reports, classified as compendium. Results section further described case details from	A

Author(s)	Title	Year	Case(s)	Type of Article and Aims (Domain 1)	Context of Citation (Domain 2)	Synthesis (Domain 4*)
					Thailand, Brazil, and Sri Lanka	
Zakariah, A et al.	The birth and growth of the national ambulance service in Ghana	2017	Ghana	Research article describing the National Ambulance Service in Ghana from 2004–2014	The Ghana NAS case is referenced mostly in historical context and why prior attempts at improving prehospital services were unsuccessful	B
Dicker et al.	Trauma, Eigth Edition: Chapter 3 Injury Prevention	2017	Thailand	Book chapter on injury prevention in surgical trauma textbook	Cited in a sub-section titled "Injury as a Global Health Problem" mentions specifically technical assistance documents by WHO and the QI example in Thailand	B
Case Study Key Elements						
Cambodia and Iraq	Training for local communities on pre-hospital life-support with mentoring programs and quality monitoring.					**Domain 3**
Ghana	Establishment of a National Ambulance Service with 7 pilot locations in 3 regions, a National HQ, Regional Medical Coordinators, and data collection systems					
Mexico	Increase the number of ambulance stations, implement a universal telephone access number and improvements in paramedic training.					
Colombia and Romania	Nationwide EMS legislation passed; Uniform standards for training EMS staff, equipment, ambulance and operating procedures, governance and enforcement measures, collaboration between government and EMS officials					
Thailand	Major TQIP implementation; Trauma Registry and use in QI; Participatory Action Research, peer review, medical audit, development of performance indicators					
Qatar	Implementation of a new hospital based trauma service; specific trauma facilities/staff; QI programs; rehabilitation services; education to clinical and non-clinical staff					
Vietnam	Established standards for infrastructure, medical equipment, and training for clinics/ hospitals in Hanoi, additional ambulance stations, improvements at Commune health stations, needs assessments in accordance with Guidelines for Essential Trauma Care					
Brazil	Creation of a dedicated rehabilitation team at an acute care hospital.					
India	Provided assistive devices, physical therapy, technical support, network strengthening for resources aimed at improving care for individuals with disabilities.					
Canada	Province wide trauma registry, accreditation of trauma centers, initiation of trauma care networks, development of triage and transfer protocols.					
Sri Lanka	Creation of a trauma secretariat and governance expansion with key groups and individuals involved in trauma care and nationwide planning.					
Synthesis Outcomes						
A	Detailed description provided, no adoption of lessons learned to a new circumstance, however, suggestion of potential replication in similar circumstances					***Domain 4**
B	Detailed description provided for historical context, no adoption of lessons learned to new circumstance, no suggestion of use in future initiatives					

Author(s)	Title	Year	Case(s)	Type of Article and Aims (Domain 1)	Context of Citation (Domain 2)	Synthesis (Domain 4*)
C	Minimal description of case, no adoption of lessons learned to new circumstance, no suggestion of use in future initiatives					

QI=Quality Improvement, TQIP = Trauma Quality Improvement Program, HQ=Headquarters, EMS = Emergency Medical Services, LMIC= Low- and Middle-Income Countries