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Staffing and Training Among Prehospital and Hospital Trauma Care Providers in Haiti

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Staffing and Training Among Prehospital and Hospital Trauma Care Providers in Haiti

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An abstract of
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Abstract

Staffing and Training Among Prehospital and Hospital Trauma Care Providers in Haiti
By Joel Kevin Bagley II

Background
The burden of trauma is disproportionally greater in low and middle-income countries (LMIC) such as Haiti. As a follow up to a previous survey in Haiti's Central Plateau, this study was designed with the goal of addressing the current state of trauma training among prehospital and hospital practitioners throughout Haiti.

Methods
A survey was designed to globally assess the needs of trauma-related care in Haiti, comprised of 13 sections containing a total of 260 questions. 59 questions were prepared with the goal of quantifying staffing and trauma training in hospital departments that care for injured patients. Medical directors, hospital administrators, surgeons, and physicians staffing the ED were questioned via interpreter to complete the survey based on interviewee knowledge and availability. Formal trauma training among physicians was defined as having taken a course in Advanced Trauma Life Support (ATLS) or ATLS-equivalent.

Results
The survey was administered at district hospitals in all 10 Departments in Haiti. 4 hospitals were designated as tertiary centers, and 6 were designated at secondary. 9 hospitals had full-time access to an ambulance. Only one of the hospitals had ambulance drivers that were medically trained. All 10 facilities had a 24-hour ED staffed by nurses and physicians, though the physicians had different levels of training across the hospitals. 2 facilities had trauma trained ED physicians. 2 hospitals had 24-hour in-house general surgeons. 3 hospitals had trauma trained surgeons. 3 facilities have offered an ATLS course at some point, but only 1 offers it every year.

Discussion
Formal training in trauma care is infrequent or absent throughout large hospitals in Haiti, despite an increased burden of disease compared to high-income counties. Formal trauma training to prehospital, nursing, and physician providers have shown benefit in LMIC and would likely benefit providers and injured patients in Haiti. This information was obtained in coordination with the Haitian Ministry of Health in efforts to improve hospital care and outcomes of trauma victims.

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CHAPTER 1: Introduction

Trauma is a leading cause of death globally. The World Health Organization (WHO) estimates that injury accounts for 16% of the global burden of disease, and 90% of that burden occurs in low and middle-income countries (LMIC). [1] Based on those numbers, approximately 5.2 million people in LMIC die every year as a result of injury—more deaths than from malaria, tuberculosis, and HIV combined. [2]

There are three ways to approach the systematic reduction of death and disability due to injury, specifically in LMIC: (1) work to prevent trauma from happening through policy and improvements in societal infrastructure, (2) improve the emergency care of injured patients, (3) improving the long-term care of injured patients including critical care and physical and mental rehabilitation. Primary prevention is the preferred method to reduce the burden of injury. The WHO and Centers for Disease Control and Prevention (CDC) advocate for increased traffic infrastructure and road safety around the world, along with many other initiatives to prevent other causes of trauma deaths. [3,4] Secondary prevention and the acute treatment of trauma patients go hand-in-hand with primary prevention. The WHO and many others are working on guidelines to reduce morbidity and mortality of injured patients in resource-limited countries. [1,5,6] Lastly, long-term care and critical care require a well-developed system of managing acutely injured patients. This paper will focus on secondary prevention of trauma in Haiti.

Haiti is a country on the Caribbean island of Hispaniola. It has approximately 10 million people with 41% unemployment, and almost 60% of its population lives below the poverty line. [7] According to the Global Burden of Disease report in 2012, Haiti's mortality rate due

to injury was 82.6 deaths per 100,00 people. [8] That is 1.5-times higher than that of the United States at 39.2 deaths per 100,000 people and 1.3-times higher than that of its island neighbor, Dominican Republic, at 62.3 deaths per 100,000 people. [8]

Haiti lacks a formal trauma system or prehospital trauma system. Additionally, Haiti lacks national standards for providers of trauma care. Addition of these national healthcare characteristics have been shown to reduce death and disability due to injury in other LMIC and should be further investigated in Haiti. [9]

1a. Problem Statement

In 2004, the WHO introduced a document to outline minimum standards of care in the field of trauma care called the *Guidelines for essential trauma care*. [1] In this document, the authors discuss fundamental skills, medical equipment, and pharmacologic agents of trauma care and define them as essential, desired, possibly required, or irrelevant based on the scale of the healthcare facility. These categories of need allow resource-limited countries, hospitals, and hospital systems to judge necessary resources based on these guidelines.

Though these guidelines are important for investment and resource allocation to hospitals in LMIC, stakeholders need to know what is already present within their system. After the publication of the *Guidelines for essential trauma care*, groups including the WHO and Surgeons over Seas released tools to assess trauma care facilities based on the guidelines. [10,11] Each of these assessments addresses the elements in the *Guidelines for essential*

trauma care with the exception of knowledge and skill. Few reports address knowledge of hospital providers. [12]

Guidelines for essential trauma care focuses on hospital resources and does not cover prehospital care. A 2015 review demonstrates examples of needs assessments for prehospital trauma systems, though none are combined with the assessment of hospital-based injury care. [13] In countries such as Haiti, these systems are often intertwined. Hospitals are not connected through a formal network of trauma care, and prehospital care is implemented by hospitals—not a large network of services.

Haiti is a country that has no trauma care network or prehospital system. To this point, no evaluation has been published of Haiti's national capacity to care for injured patients. Specifically, no evaluations of staff or training in trauma departments have been conducted or published. Lastly, there is no tool to combine the assessment of prehospital and hospital trauma care, and no survey has assesses provider knowledge and skill of trauma care within hospitals.

1b. Purpose Statement

The intention of this project was to characterize and quantify the cumulative state of staffing and training among health care providers in Departmental hospital in Haiti. This project addresses six questions and objectives:

1) What are the baseline characteristics of the Departmental hospital? These characteristics include hospital capacity for patients, basic infrastructure, and types of care that they provide.
2) What is the state of ambulance care, and what kind of training do ambulance drivers have?
3) What is the staffing in Emergency Departments? Who is present? How long are they open?
4) Are surgeons available if they are needed for trauma patients? This includes general surgeons and specialized surgeons such as orthopedic surgeons and neurosurgeons.
5) Are providers at these hospitals trained formally in the evaluation and care of trauma patients? Do the hospitals offer any training specific to trauma care?
6) Make recommendations on how to improve the care of injured patients in Haiti.

1c. Significance Statement

Appropriate staffing and training of practitioners in both prehospital and hospital settings have been shown to improve metrics of care in trauma. [14-19] Once these indices of trauma care are known in Haiti, appropriate measures can be taken to begin addressing the need established by the study. Improving the training and continuing education of trauma providers, alone, has the potential to improve provider knowledge and skill and reduce patient mortality due to trauma in Haiti.

The knowledge of the specified research questions will help in the initiation of changing the trauma system in Haiti. It may potentially fuel advocacy toward instituting change in the

trauma staffing and training. The change could come from within the Haitian government via changes in resource allocation or as a result of outside investment after displaying evidence of need. The data could also be used to apply for grants or awards from international funding sources.

1d. Definition of Terms

Trauma – injury

Training – formal teaching

Prehospital – any interaction or time between a medical incident requiring transportation to the hospital and the patient's arrival at the hospital

Provider – one of many professions who is medically training in the care of patients

Staff – those who are either employed by a hospital or use the hospital's facilities

Infrastructure – formal resources, services, and systems in place to serve larger domain or sovereignty

Low and middle-income countries (LMIC) and High income countries (HIC) – groupings defined by The World Bank based on gross national income

CHAPTER 2: Literature Review of Existing Trauma Training Courses and Associated Outcomes

Each of the training methods selected for this review are intended for health professionals with baseline knowledge of their field from existing models—with the exception of laypeople first responders. The programs outlines are intended to provide additional education in the field of trauma. The objectives of any program set up for the purpose of patient care are to increase the knowledge and skill of those participating in the course and improve outcomes of the population that they serve. The former objective is mandatory for the latter, but outcomes do not always correlate with increases in knowledge and skill. As each of these reviews demonstrates, the retention of the course material is more often studied than effects on mortality. Therefore, more systemic evaluations of patient outcomes based on these training programs could provide more decisive evidence for recommendations in developing trauma networks.

2a. Prehospital

The presence of prehospital systems in LMIC improve outcomes of injured persons. [5,20,21,22] According to the WHO's *Prehospital trauma care systems* manual, LMIC utilize three levels of prehospital care: first responder, basic prehospital care, and advanced prehospital trauma care. [5]

Layperson first responders are those who first establish contact with a victim of trauma. These are people without formal medical training but are designated, or volunteer, to provide a service to their community. Countries with or without established ambulance services train cohorts of laypeople in order to stabilize injured persons until they can reach appropriate medical care. A prospective, non-randomized, cohort study in the minefields of

rural Iraq found a significant decrease in mortality associated with the presence of village laypeople trained as first responders. [23] In fact, victims treated in the field by first responders had a lower mortality rate than those treated by first responders plus trained paramedics—4.7% compared to 13.4%. The trial results are limited by small sample size of 105 in the first responder group of the total 1341 patients and differing injury characteristics between groups.

Other programs have been set up for layperson training in the Asia and Africa that display positive outcomes, as demonstrated in a 2014 review on first responders in LMIC. [24] For instance, programs have been set up in both Ghana and Madagascar to educate commercial drivers as prehospital providers. [25,26] Each of these assessed personal knowledge and task performance after courses in first aid and transportation. Each showed a significant increase in comprehension after training. Other training systems have been set up for community members and use post-intervention tests that show both increase in pre-intervention skill level and knowledge retention. [27-29] The conclusion from these analyses is that layperson training is effective in increasing trainee knowledge and likely improves patient outcomes such as mortality in trauma systems in LMIC.

The next level of care as defined by the WHO is the introduction of a formal prehospital system and basic prehospital care. This tier of prehospital trauma care typically utilizes emergency medical technicians (EMT) and an ambulance network to triage, stabilize, and transport patients to more appropriate diagnostic and treatment facilities. Prehospital systems in LMIC rely on this level of care, compared to HIC who more often provide

advanced care. [5] The existing training systems are a heterogenous mix of certifications, orientation sessions, on-job training, and basic courses in triage and ambulance training. [17] In order to standardize the provider training, standardized EMT training courses have been developed such as Basic Trauma Life Support (BTLS), PreHospital Trauma Life Support (PHTLS), and International Trauma Life Support (ITLS).

BTLS originated in 1982 in order to standardize training among prehospital providers in the US. [30] In 2005, BTLS changed its name to ITLS in order to reflect its adoption for use in both HIC and resource-limited settings—including countries in South America, Caribbean, Europe, Asia/Middle East, and Africa. [31] The two-day course focuses on triage of patients and fast transport times to the hospital, as well as incorporating basic trauma procedures. PHTLS is a similar two-day course designed for EMT education in the US, but has extended its spectrum of locations to similar areas described for ITLS. [32]

In 2004, a group in Mexico used a prospective, before and after study to evaluate the addition of BTLS or PHTLS to the current EMT training. [17] In three different Mexican cities, the team evaluated multiple factors of EMT service including airway management, fluid resuscitation, time on scene, and mortality with the training programs typical for those environments. In one of the cities, the group introduced a widespread PHTLS training program; in another, the group introduced a widespread BTLS training program; and the last city was used a control group. The skills measured increased in frequency in both intervention arms compared to the controls, but time of scene did not change. The mortality was reduced in the PHTLS group but not the BTLS or control group. Though these

results could be convincing, the study design prevents the data from being either internally or externally valid. The PHTLS arm of the study happened six years before the other two arms. The author of the study poses that baseline progress in the emergency medical system (EMS) during this time could account for variable effects on mortality between the training programs. [17] Also, the injury characteristics between cities are different, specifically the percentages of penetrating and blunt trauma. Though this study has interesting results, the flaws in methodology make it difficult to draw conclusions comparing BTLS and PHTLS.

PHTLS is course similar to ITLS A group in Trinidad and Tobago showed a reduction of in-hospital mortality in injured patients following the introduction of PHTLS training to EMS providers from 15.7% to 10.6%. [16] The authors make a point to show similarities in patient characteristics, mechanism of injury, and injury severity between the before and after groups, as well as a multivariate regression of significant predictors of mortality that includes PHTLS training. This evaluation of PHTLS has flaws, also, in that there is no control group to compare the data over the specified time period.

The third level of prehospital care is advanced prehospital trauma care. This tier of trauma training involves advanced life support (ALS) training, which includes Advanced Trauma Life Support (ATLS) or other in-depth training that teaches advanced airway and breathing management, advanced procedures such as thoracostomy tubes and venous cut downs, and IV medication administration. [5] Providers that provide this level of training are typically specialty trained paramedics or physicians. Advanced prehospital care has limited data in

LMIC, but ALS training and procedures in HIC do not show a benefit in survival. [33-36] In fact, a Cochrane Review on the training of ambulance crews in ALS concluded an increase in mortality among patients treated by EMS providers trained in ALS when adjusting for injury severity. [36]

The conclusion of the prehospital trauma training in LMIC is complex. First responder training to laypeople provides a benefit to injured patients, specifically in rural environments or areas lacking formal prehospital trauma systems. These trainings should be contoured to the target demographic and should be validated in order to convey mortality benefits to the population. Basic prehospital trauma training both increases knowledge to trainees and likely provides mortality benefits to injured patients—though further research is needed in order to verify. ALS training among EMS providers has not been shown to provide a survival benefits to injured patients in LMIC.

2b. Nursing

In an article published in 2007 on the role of nursing in care for the injured patient, the authors conclude that when assessing hospitals in developing nations, nursing skill is disregarded when compared to physician training. [37] This is reflected in the paucity of both the availability of continuing education programs available and publications regarding patient outcome associated with nurse training. [38] There is also little data on patient outcomes in LMIC systems that have nurses trained in BLS or ATLS, though nurse training is included within some assessments of emergency systems not linked to outcomes. [39] One study conducted in India prepared a written assessment of BLS among nursing

students and nurses within the small city of Tamilnadu. [40] This report found that none of the 344 nursing students or practicing nurses received a score greater than 70%. Despite the high potential for selection bias because not all students and faculty were surveyed, the result is striking. Though this publication does not directly relate to trauma training, it conveys the lack of emergency preparedness training among nurses in this setting.

There are 2 widespread programs in HIC designed to improve nursing care in the setting of injury: Trauma Nursing Core Course (TNCC) and Advanced Trauma Care for Nurses (ATCN). These courses, also, have not been linked with patient outcomes, though both TNCC and ATCN have been shown to increase performance in knowledge-based and scenario assessments in HIC [41] There are few qualitative descriptions of TNCC being taught as humanitarian missions, but no reports of systematic implementation or results. [42,43] These courses are potentially less applicable in resource poor environments due to costs, time commitment, and limited applicability of subjects such as ventilator management.

There is another training model that is not specific to but involves nurses called Trauma Team Training (TTT). The course was developed in Uganda as a joint project between Canadian Surgeons and Ugandan Injury Control Centre as a trauma training program for nurses, physicians, and other team members specifically in low-resource settings. [18] During a 2013 evaluation of TTT in Guyana, nurses had the most substantial improvement in testing and the highest level of retention of knowledge among all subgroups. [18] This result is significant despite the small sample size of 17 nurses in the study. Along with the

quantitative analysis, the research group interviewed study participants in Guyana and qualitatively analyzed the responses. Study participants felt more knowledgeable in trauma scenarios, felt that they were empowered in their current positions, and non-physicians were given increased responsibility because of their skills obtained in the course. [18] The qualitative data is potentially biased because of the high rate of attrition in the study—15 participants were not included because they did not return for the four-month retention evaluation. Though this course is well described in the literature, it lacks an evaluation relating to patient outcomes.

The evaluation of these programs in the literature describes a need to increase knowledge and skill in global trauma and emergency nursing through continuing education. ATCN, TNCC, or TTT all provide an increase in nursing provider knowledge of injury-related care and comfort in those clinical situations. However, there have been no evaluations of their effect on patients or health systems and cannot be extrapolated from the current body of research.

2c. Physician

Physician trauma training is recognized as an important part of care for the injured patient globally. [1] Many courses are available to low-resource countries. These courses include Trauma Team Training (TTT), Advanced Trauma Life Support (ATLS), National Trauma Management Course (NTMC), Primary Trauma Care (PTC), and Kwame Nkrumah University of Science and Technology Trauma Course (KNUSTTC).

The most well known of these courses, in both HIC and LMIC, is Advanced Trauma Life Support (ATLS). ATLS is a three-day course developed by The American College of Surgeons in order to standardize the assessment of injured patients by physicians in an algorithmic manner. [44] Since its inception in the US in the 1970's, the course has been formally taught in more than 50 countries around the world and informally taught in many more. [45] In 2014, the Cochrane Review concluded that there is not enough controlled evidence to support the teaching of ATLS, regardless of resource limitation. [46] This review, however, excludes multiple studies because of methodology that have important findings, specifically in LMIC.

One group in Trinidad and Tobago demonstrated multiple benefits of ATLS training after introduction of a program to institute ATLS training to physicians in the capital city. [14,15,47] During a randomized control trial, this group showed that ATLS training increases knowledge in trauma scenarios based on multiple choice tests and practical clinical examinations. [15] Through a retrospective, before and after study looking at 9 years of emergency department (ED) visits, they showed a reduction in overall mortality from 68% to 34% and an increase in the use of advanced life saving procedures in the ED following ATLS training in a large, teaching hospital. [14,15] Though the trial was retrospective, the cohorts of patients in the pre-intervention and post-intervention groups were shown to be similar in age, sex, injury severity, and mechanism of injury. The reduction in mortality was shown through all levels of injury severity except for the most severely injured patients. The most significant flaw in the study design is the lack of a control group, but the institution of a control in a systematic intervention is difficult.

A similar retrospective, before and after trial in China showed a reduction in mortality from 19% to 15% after the initiation of ATLS training. [48] Their results are less convincing due to differences in patient and injury characteristics in the pre- and post-intervention groups. Conversely, a study of Greek physicians showed an increase in mortality among those trained in ATLS over those without formal training. [49] Even though Greece is a HIC, it is included here to show a contrasting outcome. Even on sectioned analysis of mortality based on injury severity, non-ATLS trained physicians had reduced patient mortality in all categories. This analysis is limited by a short study time and limited selection of included hospitals, but the results are dramatic. Lastly, a systematic review conducted in 2014 concluded that ATLS benefits provider knowledge and comfort in trauma situations, though it urged the need for future research in order to deduce an effect on patient outcomes based on the opposing results in the contemporary literature. [50]

Trauma Team Training (TTT) is a similar three-day course developed by the Canadian Network for International Surgery in conjunction with the Ugandan Injury Control Centre. [18] The two major differences between TTT and ATLS are that TTT focuses on a team based approach that includes non-physician hospital staff in the training and its targeted approach to a resource poor setting. There are two published evaluations of this training program, each with similar methods of assessing trauma knowledge and skills plus satisfaction with the course. One is a small group of physicians and nursed participating in TTT in urban Tanzania. [51] The group was assessed before the course then again after with an individual multiple-choice test and team scenario test involving a patient with

multiple injuries. There was a significant increase in average post-test score, though only 85% of the participants passed with a grade higher than 60%. (Also, physicians and nurses were analyzed together with no data for each group independent of the other.) Each of the teams scored higher than 85% on all of the scenarios, and a majority felt more comfortable in trauma scenarios after having taken the course. The second study is an evaluation of the TTT course in Guyana. [18] The evaluation of participants included similar pre-test, post-test, and team-based scenario of a patient encounter, then also included a follow-up test at four months and a qualitative interview with course participants. Physicians had an increase in average post-test and follow-up score when compared to the pre-test average, but neither was significant at an alpha of 0.05. In the qualitative evaluation at the four-month follow, doctors voiced a reiteration of knowledge, and a group-wide theme of improved teamwork evolved. Each of these studies is limited by a small sample size of 20 and 47, respectively. Also, each assessed only knowledge and skill without a correlation to patient outcomes.

A recent prospective, before and after study based out of urban Rwanda trained doctors and nurses at a public teaching hospital using either ATLS or TTT and assessed pre- and post-training mortality of injured patients. [19] The two courses were not compared. The analysis included a comparison of pre- and post- intervention patient and injury characteristics, which were similar in age, sex, vital signs, neurologic status, and percentage of penetrating injury. The overall ED mortality decreased, though not significantly, from 8.8% to 6.3%. There was a significant decrease in mortality in a cohort of patients with poor neurologic status from 58.5% to 37.1%. Study limitations include lack of a control

group and failure to separate the data from independent course participants—ATLS and TTT. And though the data is not conclusive, it is another suggestion that additional trauma training among team members positively effects patient outcomes.

Primary Trauma Care (PTC) is a two-day course that was developed by a society of anesthesiologist designed to train doctors and other health professionals in rural, low-resource hospitals on trauma basics by focusing on an algorithmic initial assessment of injured patients. [52] It was originally introduced in the South Pacific then has gained popularity around the world. [52] There is little data on the effectiveness of the training program except for a 2013 article evaluating pre- and post-course tests at a medical university in Iran. [53] The study showed a significant increase in knowledge regarding trauma care following the course, but a lack of retention of that knowledge. This evaluation does not give an accurate understanding of the primary goal of this course—to increase the quality of trauma care in rural environments.

Two other courses that have been developed include the National Trauma Management Course (NTMC) and Kwame Nkrumah University of Science and Technology Trauma Course (KNUSTTC). NTMC was developed as a coordinated effort between Switzerland and India's Academy of Traumatology. It was developed for as a low cost initiative to improve injury care in rural India and other LMIC. (WHO Essential) This literature review yielded no data regarding the effectiveness of this course. The KNUSTTC is a course that was developed in Ghana and designed specifically towards the local needs of providers for treating victims of trauma. [54] It was internally validated by testing trainees with a

standard evaluation before and after the course. Analysis of the data showed a significant increase in the average score of the post-course test compared to the pre-course test. This study does not have an analysis on patient outcomes but did have a qualitatively positive impact on patient care per the course participants that returned for follow-up interviews.

2d. Conclusion

The conclusion in the review of literature on training in the care of injured patients is not well defined. Of all of the trials and reviews, many showed positive effects on trainees and patients while few demonstrated negative effects to patients. The effect of training is hard to measure alone. There are many factors at work in the system surrounding trauma care that make one aspect of the system almost impossible to isolate. For this reason, the outcomes and biases of this body of literature must be interpreted on an individual basis.

CHAPTER 3: MANUSCRIPT

3a. Title Page

Staffing and Training Among Prehospital and Hospital Providers in Haiti

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To be Submitted to the World Journal of Surgery

3b. Contribution of Student

I began work on this project from the initial proposal in 2014. Since then, I have contributed to the planning of project objectives, funding proposals, data collection, data analysis, writing of the manuscript, and creation and formatting of the tables and figures.

3c. Abstract

Staffing and Training Among Prehospital and Hospital Trauma Care Providers in Haiti

Background
The burden of trauma is disproportionally greater in low and middle-income countries (LMIC) such as Haiti. As a follow up to a previous survey in Haiti's Central Plateau, this study was designed with the goal of addressing the current state of trauma training among prehospital and hospital practitioners throughout Haiti.

Methods
A survey was designed to globally assess the needs of trauma-related care in Haiti, comprised of 13 sections containing a total of 260 questions. 59 questions were prepared with the goal of quantifying staffing and trauma training in hospital departments that care for injured patients. Medical directors, hospital administrators, surgeons, and physicians staffing the ED were questioned via interpreter to complete the survey based on interviewee knowledge and availability. Formal trauma training among physicians was defined as having taken a course in Advanced Trauma Life Support (ATLS) or ATLS-equivalent.

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The survey was administered at district hospitals in all 10 Departments in Haiti. 4 hospitals were designated as tertiary centers, and 6 were designated at secondary. 9 hospitals had full-time access to an ambulance. Only one of the hospitals had ambulance drivers that were medically trained. All 10 facilities had a 24-hour ED staffed by nurses and physicians, though the physicians had different levels of training across the hospitals. 2 facilities had trauma trained ED physicians. 2 hospitals had 24-hour in-house general surgeons. 3 hospitals had trauma trained surgeons. 3 facilities have offered an ATLS course at some point, but only 1 offers it every year.

Discussion
Formal training in trauma care is infrequent or absent throughout large hospitals in Haiti, despite an increased burden of disease compared to high-income counties. Formal trauma training to prehospital, nursing, and physician providers have shown benefit in LMIC and would likely benefit providers and injured patients in Haiti. This information was obtained in coordination with the Haitian Ministry of Health in efforts to improve hospital care and outcomes of trauma victims.

3d. Introduction

Trauma, or injury, is one of the three leading causes of death globally among those ages 5 to 44, and its ranking is predicted to be rising throughout all age groups. [1] The WHO estimates that injury accounts for 16% of the global burden of disease, and 90% of that death or disability occurs in low and middle-income countries (LMIC) such as Haiti. [2] In light of these statistics, trauma in low-resource nations has become a topic of international discussion.

The WHO has published a series of guidelines to set minimum standards for the delivery of injury-related care. [2-4] These guidelines focus on both physical resources and knowledge associated with the initial evaluation and resuscitation, especially in the Guide to Essential Trauma Care. While many needs assessment tools have been developed to focus on the tangible supplies and personnel of hospitals in LMIC, few have focused on trauma training among the providers to assess the component of knowledge. [5-8]

As a follow-up to our group's previous effort to characterize surgical capacity in Haiti's Central Plateau, we modified our previous survey tool to assess the capacity for trauma care in hospitals across Haiti. [9] The goal of this analysis is to characterize the strengths and weaknesses in staffing and trauma training within trauma related divisions in Departmental hospitals in Haiti.

3e. Methods

This is a cross-sectional study designed to assess the current staff and staff training in trauma-related departments among Departmental hospitals in Haiti. Haiti consists of 10 Departments, or sovereign districts. We targeted the largest public hospital in each Department in order to capture the referral centers throughout the country. These hospitals treat the highest number of patients and are overseen by the same governmental body, Haiti's Ministry of Health officially known at Ministere de la Sante Publique et de la Population (MSPP). This analysis is a part of a larger collaboration between the Haitian MSPP, Project Medishare for Haiti, and Emory University School of Medicine to more comprehensively assess the current state of trauma care in Haiti.

In order to assess the physical and personnel resources involved in trauma care at the hospitals, our group created a unique survey tool. This tool was based on the World Health Organization's Tool for Situational Analysis to Assess Emergency and Essential Surgical Care and a our group's previous effort to characterize surgical services in Haiti's Central Plateau. [9] These previously published survey tools were adapted to include specific trauma resources and personnel based on WHO's Guide to Essential Trauma. In order to assess the knowledge component of this guide, we included a section to assess formal training in the care of an injured patient. The survey consisted of 13 sections and 260 questions, 59 of which are directly related to this analysis regarding staff and training.

Each hospital was visited between June 2014 and February 2015 where the survey was administered to hospital staff. If any information was missed during the visit, we attempted

to collect the information via follow up phone calls to hospital administration or appropriate personnel. Hired translators were trained on the administration and content of the survey prior to the visits. At each of the hospitals, the survey was administered to hospital personnel with the help of these trained interpreters. Multiple people were interviewed in order to complete a single survey at each of the hospitals. Positions that were interviewed regarding the training and staffing consisted of Hospital Administrators, Medical Directors, or chiefs of hospital departments.

The data was collected and input electronically through Adobe Form. In the analysis of hospital demographics, a hospital was deemed to have access to emergency packed red blood cells (PRBC) if the blood could be obtained within 15 minutes and was available greater than 90% of time. Trauma guidelines were defined as a set of written procedures to be followed when an injured patient arrived at a hospital. With regards to staffing, in-house is defined as a person being on the hospital campus, which included dormitories or other forms of housing. On-call is defined as a person not on the hospital campus but able to be contacted if their services are needed without limitation regarding proximity to the hospital. Finally, formal trauma training was defined as having taken a course in Advanced Trauma Life Support (ATLS) or an ATLS equivalent.

The project was granted exemption from Emory University IRB after a formal review process because there was no involvement of human subjects, and the Haitian Bioethics Committee, a division of MSPP, approved the project.

3f. Results

10 different hospitals were visited across the country of Haiti, each in the capital city of their respective Department. (Figure 1) (Table 1) 7 of these hospitals are independently operated by the MSPP, while 3 of them are operated by the MSPP in collaboration with a private entity. 4 of the hospitals act as regional referral centers and serve a population greater than 700,000 people. Hospitals in this group are designated as tertiary centers. The remaining 6 are designated as secondary hospitals because they act as Departmental referral centers and serve a population less than 700,000. [A primary hospital would be a community level hospital that does not act as a referral center.]

The tertiary hospitals have an average of 248 beds per hospital and 4.75 operating rooms. On average, 97.5% of time they have electricity available and 75.0% of time have running water. All 4 have a 24-hour Emergency Department (ED), 1 of the centers has an Intensive Care Unit (ICU), 1 has access to emergency packed red blood cells (PRBC), 1 has formal guidelines for trauma care, and none have a formal trauma registry.

The secondary hospitals have an average of 85 beds per hospital and 1.83 operating rooms. On average, 82.5% of time they have electricity and 68.3% of time with running water. All 6 have a 24-hour ED, 1 has access to emergency PRBC, 1 has formal trauma guidelines, and none have a trauma registry. Table 2 has additional information regarding characteristics of the surveyed hospitals.

Prehospital (Table 3)

1 tertiary hospital did not participate in this area of the survey because it utilizes a new government ambulance service for its prehospital care that is not directly affiliated with the hospital.

Each hospital has access to an ambulance, but not all of those ambulances are functional. The tertiary hospitals had, on average, access to 2.3 functional ambulances where secondary hospitals had access to 1.3. Only one hospital, a secondary facility, did not have access to any functional ambulances.

1 hospital said that they had ambulance drivers with medical training, though the nature of the training was not specified. At every hospital that had an ambulance, it was available at all times with a driver on call. 1 tertiary center had ambulance drivers with government-established, non-medical driver training. 3 secondary hospitals had ambulance drivers with non-medical driver training, 2 of which indicated that it was government ambulance driver training.

Emergency Department (Table 4)

Each of the 10 facilities has a 24-hour ED. All 10 facilities have a nurse in the ED at all times and all of the 10 facilities have a physician covering the ED at all times. The tertiary hospitals have either a social service year doctor or a resident covering the ED. Social Service year is a mandatory year of service to Haiti between medical school and residency. 3 of these facilities do not any physicians staffing the ED with formal training in trauma

care. At the 1 facility with trauma trained physicians, 30% of the ED physicians have formal trauma training. The secondary hospitals have either social service year doctors, residents, or generalists covering the ED. 1 of these secondary hospitals has any physicians covering the ED that has formal training in trauma. At that hospital, 50% of the physicians staffing the ED have trauma training. (Table 6)

General Surgery (Table 5)

We have data on 9 of the 10 hospitals for general surgery departments. 2 of the tertiary hospitals had general surgeons in-house at all times. At these 2 hospitals, the surgeons in-house are residents. All 4 tertiary centers had a general surgeon on-call at all times. Each of these hospitals specified that the person on-call is always an attending physician. 2 tertiary hospitals had trauma trained general surgeons. At those facilities, an average of 75% of the general surgeons were trauma trained. Zero of the 5 secondary hospitals surveyed had a general surgeon in-house at all times. All 5 of those hospitals had a general surgeon on-call at all times—either residents or attending physicians. 1 of the secondary hospitals had general surgeons that were trauma trained. 50% of the surgeons at that one facility were trained. (Table 6)

Surgical Subspecialty Related to Trauma (Table 5)

We have data on 9 of the 10 hospitals for orthopedic surgery departments and neurosurgery departments. All 4 of the hospitals surveyed had an orthopedic surgeon on-call at all times, while only 1 had a neurosurgeon available. 1 of the 5 secondary hospitals had orthopedic surgery on-call, and none had a neurosurgeon available at their facility.

Continuing Education (Table 7)

There is a sparsely organized system for continuing education throughout the Departmental hospitals. Only 1 of the hospitals surveyed had a schedule for in-service training and conferences. A total of 7 facilities said that they offer some form of continuing education, but all but one hospital said that these were not consistent occurrences. The most common source of training was international medical teams visiting the hospitals. Of those seven hospitals that offered in-service training, only one listed trauma as a topic that had been covered.

3 of the facilities have ever offered their staff a course on trauma training. 2 of the 3 stated that the course is not offered on a consistent basis, one stating that it had been over five years since the last installment. 1 of the 3, a tertiary center, offers a trauma training course one time per year.

3g. Discussion

Using a unique survey tool specific for Haiti, our group set out to assess the current state of staffing and training in trauma-related departments in public referral hospitals in Haiti. The results show positive and negative aspects of the current state of the hospitals, all of which have been reported back to our partners at the MSPP. The positive characteristics include overwhelming availability of ambulances at most hospitals, 24-hour ED at all hospitals, and all hospitals have general surgeons on call at all times. Some of the findings requiring attention include subspecialty staffing, formal training among all providers, and

continuing education programs. Subspecialty training is a complex matter that requires in-depth discussion outside of trauma education. The other areas of need are need are encompassed within trauma training. Formal training in the care of the injured patients is an essential part of trauma systems in LMIC. [2,10] Therefore, training and continuing education in injury-related care is needed in Haiti for prehospital providers, nurses, and physicians treating victims of trauma.

There are three main strengths of this study. First, there is specificity in those who participated in the survey. Persons chosen to participate were chosen because of their knowledge of a given area of the hospital. Administrative positions were chosen for the questions regarding staffing and training because they are involved in the maintenance of hospital personnel. Next, our group's visitation of each hospital allowed for clarification of questions, feedback from survey takers, and direct observation of care. It also allowed us to create contacts that facilitate long-term relationships with administrators and providers in Haiti. Lastly, this study's principle strength is its assessment of training by directly asking about formal training and continuing education. Three well-known hospital assessments indirectly evaluate knowledge and training via types of procedures performed, while only one relies on training courses as a measure of this competency. [5-8] This survey more directly assesses formal trauma training, which has a direct correlation to outcomes for providers and patients. [10-12]

There are also limitations of this study. Numerous positions at each hospital were surveyed for the assessment, so there is potential for sampling bias. Because of the need for so many

participants, one survey was incomplete due to inability to contact one hospital administrator. Another limitation is that this survey is intentionally limited to departmental hospitals within Haiti. This was done in order to focus on the public sector hospitals overseen by MSPP, which allows for recommendations within one body that are more easily enacted and eventually enforced. Unfortunately, this excludes a number of hospitals that care for Haitian trauma patients. Last are the limitations of the study design. A cross-sectional study design depicts a point in time does not reveal the ongoing changes in hospitals. A survey is opinion-based and could reflect the bias of those administering or responding to the survey.

Training for first responders and basic prehospital trauma providers has been shown to improve knowledge and skill of these providers. [13-15] In the setting of an existing trauma system, it has even been shown reduce mortality of injured patients. [16] The Centre Ambulance Network (CAN) is a government project started in Port-au-Prince being dispersed throughout the country. Administrators are currently working with local non-governmental organizations on a plan to provide standardized prehospital training to ambulance staff. In the developing prehospital system in Haiti, first responder training among ambulance drivers would likely improve overall patient care as opposed to basic trauma life support which is designed for a more developed system. [3]

Injury training among nurses is commonly overlooked compared to physicians in LMIC. [17] Nurse training is an important part of trauma care because they are commonly the first to evaluate incoming patients, they participate in resuscitations, and they are strong

patient advocates. [17] Courses such as Trauma Nursing Core Course and Advanced Trauma Care for Nursing are two courses developed in HIC that have not made strides in resource-poor settings. Other programs such as Trauma Team Training are available in LMIC and have shown benefit to students of the course and qualitatively improve patient care, but these courses are not exclusive to nursing care. [19-20]

Physician training in trauma care in LMIC has been demonstrated in some studies to improve overall mortality among injured patients [10,20] Advanced Trauma Life Support is the most commonly recognized of such courses, but other courses developed specifically for low-resource settings such as Trauma Team Training and Primary Trauma Care course have been shown to confer similar knowledge and skill with a smaller cost of operation. [2]

As shown in the results of this assessment, Social Service physicians and residents cover the ED throughout Haiti and are the first to evaluate and resuscitate victims of trauma. These inexperienced physicians have much responsibility and large volumes of patients, often acting as sole physician in emergency rooms. Therefore, having a two or three-day training course before the Social Service year—either at the end of medical school or as an adjunct to Social Service orientation—is likely to demonstrate the most substantial impact.

Each of the discussed providers involved in care of the injured patient in the Departmental hospitals in Haiti are in need of additional trauma training. For each level of care, the training program should be individualized and standardized by the MSPP. By standardizing

the training programs, the MSPP can more easily monitor and evaluate, then make modifications as needed.

In order to recommend specific programs for prehospital providers, nurses, and doctors, one needs to have an intimate knowledge the Haitian healthcare system, as well as legislative and fiscal matters associated with national healthcare. In order to collect that expertise, we recommend the creation of a multidisciplinary trauma committee under the supervision of MSPP. This group could serve to make recommendations on specific training programs, implement those recommendations, monitor compliance, and evaluate effectiveness. It could also serve to advocate for further change in trauma care including eventual formation of a formal trauma care network and national data collection—other elements desirable in LMIC trauma care. [21]

3h. Conclusion

Trauma training among providers who care for injured patients at Departmental Haitian hospitals is an area that requires attention. Plans to improve training among various providers should utilize strengths among these hospitals where they exist. As Haiti is in the early stages of a formal prehospital trauma system and hospitals have access to ambulances, ambulance driver training that emphasizes the reduction of time to hospital is likely to positively effect patient outcomes. ED nurses and physicians are present at all times, so trauma training with a formal course among these providers has potential to benefit patients. Physician training should be focused initially towards Social Service doctors. For the institution of specific trauma courses and continuing education, we

recommend a Haitian, multidisciplinary team that can draw from knowledge and experience of government, healthcare, and community outreach. Further research is needed to follow the effects of the chosen programs for both caregivers and patients.

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3j. Tables and Figures

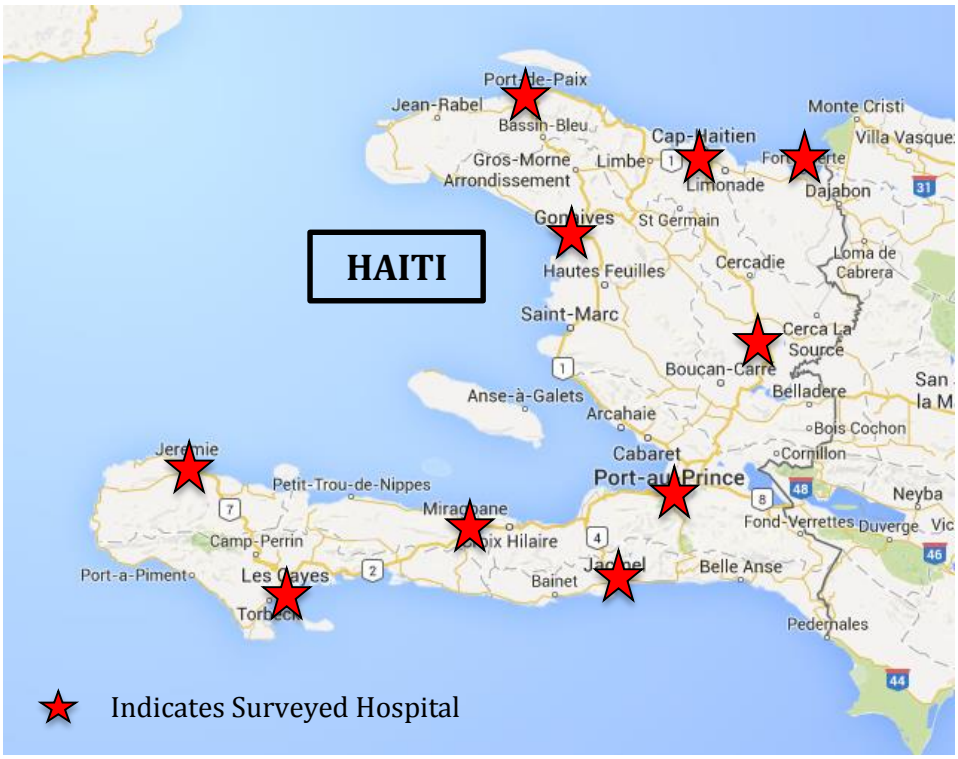

Figure 1. Map of Haiti and Location of Hospitals Surveyed from June 2014 to February 2015

Table 1. Hospitals Surveyed in Haiti from June 2014 to February 2015

Hospital	City	Department	Private/ Public	Population Served [22]	Classification
Hopital de l'Universite d'Etat d'Haiti	Port-au-Prince	Ouest	Public	3,664,620	Tertiary
Hopital Universitaire Justinien	Cap Haitien	Nord	Public	970,495	Tertiary
Hopital Immaculee Conception des Cayes	Les Cayes	Sud	Public	704,760	Tertiary
Hopital de la Providence	Gonaives	Artibonite	Public	1,571,020	Tertiary
Hopital Ste.-Antoine de Jeremie	Jeremie	Grand'Anse	Mixed	425,878	Secondary
Hopital Immaculee Conception	Port-de-Paix	Nord-Ouest	Public	662,777	Secondary
Hopital Ste. Michel de Jacmel	Jacmel	Sud-Est	Public	575,293	Secondary
Hopital Ste. Therese de Hinche	Hinche	Centre	Mixed	678,626	Secondary
Hopital de Fort-Liberte	Fort Liberte	Nord-Est	Mixed	358,277	Secondary
Hopital Ste. Therese de Miragoane	Miragoane	Nippes	Public	311,497	Secondary

Table 2. Characteristics of the Departmental Haitian Hospitals Surveyed, June 2014 - February 2015

	Secondary	Tertiary
N	6	4
Total Beds per hospital, mean (range)	84.8 (40-157)	247.5 (90-500)
Operating Rooms per hospital, mean (range)	1.83 (1-3)	4.75 (2-12)
Number of hosptials with ICU, n (%)	0 (0%)	1 (25%)
Percent time with electricity, mean (range)	82.5% (50-100)	97.5% (90-100)
Percent time with running water, mean (range)	68.3% (0-100)	75% (50-100)
Number hospitals with Emergency PRBC*, n (%)	2 (33.3%)	1 (25%)
Number of hospitals with Trauma Registry, n (%)	0 (0%)	0 (0%)
Number hospitals with Trauma Guidelines, n (%)	1 (16.7%)	1 (25%)
Number of Hospitals with 24 hr ED, n (%)	6 (100%)	4 (100%)

PRBC = packed red blood cells; ED = Emergency Department

Table 3. Prehospital Availability and Training at Departmental Hospitals in Haiti, June 2014-February 2015

	Secondary	Tertiary*
Number of Ambulances Per Hospital, average (range)**	1.3 (0-2)	2.3 (2-3)
Number of Hospitals with Trained Ambulance Drivers, n (%)	3 (50%)	1 (33%)
Number of Hospitals with Ambulance Drivers with Medical Training, n (%)	1 (17%)	0 (0%)

*n=3

**All functional ambulances were available 24 hours/day

Table 4. Persons Staffing Departmental Hospital Emergency Departments in Haiti, June 2014-February 2015

	Secondary	Tertiary
24 Hour Nursing, n (%)	6 (100%)	4 (100%)
24 Hour Physician, n (%)	6 (100%)	4 (100%)
Social Service, n (%)	5 (83%)	3 (75%)
Resident, n (%)	1 (17%)	2 (50%)
Generalist, n (%)	1 (17%)	0 (0%)

Table 5. Number of Departmental Hospitals in Haiti with Surgical Staff Available 24-hours per day, June 2014-February 2015

	Secondary*	Tertiary
General Surgery In-House, n (%)	0 (0%)	2 (50%)
General Surgery On-call, n (%)	5 (100%)	4 (100%)
Orthopedic Surgery On-call, n (%)	1 (20%)	4 (100%)
Neurosurgery On-call, n (%)	0 (0%)	1 (25%)

*n=5

Table 6. Number of Haitian Departmental Hospitals Staffing Physicians with Trauma Training, June 2014-February 2015

	Secondary*	Tertiary
Physicians Staffing ED,** n (%)	1 (20%)	1 (25%)
General Surgeons, n (%)	1 (20%)	2 (50%)

*n=5
**ED = Emergency Department

Table 7. Number of Haitian Departmental Hospitals who Offer Continuing Education, June 2014-February 2015

	Secondary*	Tertiary
In-service Training, n (%)	4 (80%)	3 (75%)
Trauma as subject of in-service, n (%)	1 (20%)	0 (0%)
ATLS or ATLS-equivalent, n (%)	1 (20%)	2 (50%)

*n=5

CHAPTER 4: Discussion and Recommendations

Using a unique survey tool, our group set out to assess the current state of providers of trauma care in public referral hospitals in Haiti. There are positive aspects of the current hospitals that include ambulance availability, 24-hour ED availability and staffing, and hospitals with 24-hour general surgeons on-call. Some of the more dramatic areas needing improvement are infrastructure support such as access to running water, subspecialty staffing, provider training, and continuing education. Infrastructure is outside the scope of this discussion but has been addressed with our MSPP partners. Formal training in the care of injured patients, though, is an essential part of any developing hospital system in LMIC based on the fundamentals outlined in the Guidelines for essential trauma care. [1,19] Training and continuing education in injury-related care is an area of need in Haiti for prehospital providers, nurses, and physicians treating victims of trauma.

The strengths of this assessment are the specificity of those surveyed, the personal visitation of each site, and the inclusion of training in the assessment. Persons that were surveyed were chosen specifically because of their knowledge within their domain of the hospital. For the assessment of the personnel and training, the survey was administered to hospital administrators and those involved in staffing. Next, visitation of each site was essential to our study and our hopeful impact on the healthcare system. Because we were present at each hospital, we were able to visualize physical resources and clarify questions from the survey; each of these were critical when giving feedback and making recommendations to our partners at MSPP. The personal interaction with administrators and staff at each of these hospitals also provides an environment suited for long-term relationships. Lastly, we directly questioned hospitals regarding prehospital and physician

training. Other assessments of trauma care have assessed emergency procedures done at particular hospitals as a metric for training and knowledge; one included trauma education as a metric. [10,11,12,54] There are benefits to each. Increased number of procedures performed in the ED has been correlated to providers having taken ATLS courses. [15] We chose to assess knowledge via a formal course because it is a more direct assessment and previous trials have proven a correlation between having taken a course in trauma care and positive outcomes for providers and patients. [15,19,50]

Limitations to this study include a sampling bias because such a variety of people were assessed for a single survey. Because of the many positions needed for each survey, one hospital survey was incomplete due to inability to contact an administrator with pertinent information. Another limitation of the study itself is the cross-sectional approach, which cannot reveal the changes to the system before or after the study. The most notable part of this limitation is the ongoing advances to prehospital care discussed at another point in this article. Though it is a representation of trauma-care capacity in Haiti, this is also not a comprehensive picture of the healthcare system in Haiti because we surveyed only the largest Departmental facilities. Haiti is a country that depends on foreign aid and missionary-based healthcare. Many private hospitals are not depicted in this assessment, such as Partners in Health hospitals, Project Medishare's Bernard Mevs Hospital, and a number of other privately funded institutions that care for injured Haitians. Lastly, a language barrier is a potential source of error in any study within an international setting. Even though our translators were trained, we found concepts that did not translate from English to Creole or French, the national languages of Haiti.

4a. Prehospital

Training for first responders and basic prehospital trauma providers has been shown to improve knowledge and skill of these respective health care professionals. [17,23,24] In some studies, the addition of continuing education courses in trauma care—specifically those focused on reduction of time to hospital—to an existing prehospital system reduced mortality among injured victims who survived until the hospital. [16] After the recent development of Haiti's Centre Ambulance Network (CAN), administrators are working with local non-government organizations (NGO) to provide formal prehospital training to the ambulance drivers. MSPP officials are also working to disseminate this public ambulance service to major cities across the country.

First responder training has been shown to reduce mortality in countries lacking a formal prehospital system. [23] Haiti is currently lacking a prehospital system, though it is in the early stages of developing one. While basic prehospital life support is effective in improving patient outcomes in an existing system, it does not appear that Haitian ambulance drivers would benefit from a course such as PHTLS or ITLS. Because there is a rudimentary system is in place, though, it should be utilized. Until the complete development of a prehospital system, we recommend standardized driver training to all ambulance drivers that emphasizes reduced time to the hospital. This would create an environment similar to that of cities with commercial, non-ambulance commuters in previous studies in Ghana and Madagascar. [25,26]

4b. Nursing

Injury training among nurses is commonly overlooked compared to physicians when evaluating trauma systems in LMIC. [37] In fact, our own survey neglected the subject—though we include nurse staffing in the ED and other departments (not included in this analysis). Nurse training is an essential part of trauma care because nurses are commonly the first to evaluate patients, they are a critical part of the resuscitation team, and they are patient advocates within hospitals. [37] Though programs such as Trauma Nursing Core Course (TNCC) and Advanced Trauma Care for Nurses (ATCN) have not made strides in LMIC, there are programs such as Trauma Team Training that incorporate nurses into training models. [18,51] The inclusion of nurses into team resuscitation training has been qualitatively shown to empower nurses, improve communication, and improve overall patient care. [18] As Haiti introduces formal trauma training to healthcare workers, we recommend the inclusion of nurses in the training courses to encourage a positive team dynamic and improve patient outcomes.

4c. Physician

Additional training in trauma care among physicians in resource poor settings has been demonstrated to improve overall mortality among injured patients. [14,19] Though Advanced Trauma Life Support (ATLS) is the most recognizable in both HIC and LMIC, there are other courses such as Trauma Team Training and Primary Trauma Care course that have been shown to increase knowledge and improve skills involved in injury scenarios. [1,18,53,54] These courses have been designed for integration in low-resource settings and are available at substantially lower costs than ATLS.

As shown in the results, a majority of the physicians who work in ED are either Social Service year physicians or resident physicians, typically without an attending physician present in the ED. This means that physicians with least amount of training are the first to evaluate and stabilize trauma patients. With that in mind, integration of a formal trauma training course at the end of medical school or just before the Social Service commitment could improve the care of injured patients. The course offered should be a comprehensive course that includes a knowledge component, a skills component, and a component that emphasizes a team approach to maximize the human resources in an understaffed hospital system. Because retention of knowledge from a one time course has been shown to be low, continuing education should be offered to those involved in emergency care and general surgery—those who most immediately respond to trauma patients. [18,53]

Any of these training programs would be difficult to implement in a country with trauma system, but it will be even more challenging in Haiti—a country without a formal trauma care network. In this case, we recommend a formal committee be instituted within the MSPP regarding trauma care. This trauma committee would be a multidisciplinary team of physicians, nurses, prehospital providers, hospital administrators, financial advisors, and community leaders. For the purposes of trauma education, this committee would serve multiple purposes: (1) Pick an appropriate training course for each discipline. The expertise in government affairs, financial support, and trauma practitioners allows for maximum benefit to the Haitian system. (2) Set a plan for implementation of this trauma course across the country. (3) Set and implement a standard for all practitioners (4) Set up

a data collection system that would allow for monitoring, evaluation, and necessary modification of the plan.

Though the initial goal of this multidisciplinary trauma is trauma education, its creation could benefit multiple facets of trauma care in Haiti. It could act as an advocate for goals of trauma care within the MSPP. It could act as an international point of contact for grants and donations. Lastly, it could begin discussions on the initiation of a formal trauma care network, which have been shown to reduce mortality in other LMIC. [9]

4d. Recommendations Regarding Healthcare Provider Trauma Training in Haiti

1) Institute an ambulance driver education course as a part of CAN that emphasizes reduced prehospital time.
2) Institute a course for hospital providers—nurses and physicians—that emphasizes knowledge of trauma evaluation, resuscitation, and team collaboration. Physician training should be instituted before the Social Services year.
3) Set national standards for continuing education among those involved in trauma care.
4) Create a multidisciplinary trauma committee under the supervision of MSPP. This group would be responsible for selecting and implementing appropriate trauma courses, setting national standards for enrollment, and monitoring and evaluating its effects on providers.

Based on data published in the scientific literature, the first three recommendations would likely improve knowledge among all providers caring for trauma patients and have the potential to improve patient outcomes in Haiti. The fourth recommendation serves two goals: (1) it provides a way to implement the first three recommendations from within the Haitian political system, and (2) it provides a construct for quality improvement in Haitian trauma care.

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Appendix: Survey Tool

Hospital

City

Facility Level

Medical Director

Phone Number

Email address

Number of Beds

Number of Operating Rooms

EPIDEMIOLOGIC DATA (Survey Questions)

Trauma cases per month (subjective)

◯ 1-5 ◯ 6-10 ◯ 11-25 ◯ 26-50 ◯ 51-75 ◯ 76-100
◯ 100-200 ◯ 201-300 ◯ 301-400 ◯ 401-500 ◯ <1

Adult Trauma cases per month (subjective)

◯ 1-5 ◯ 6-10 ◯ 11-25 ◯ 26-50 ◯ 51-75 ◯ 76-100
◯ 100-200 ◯ 201-300 ◯ 301-400 ◯ 401-500 ◯ <1

Pediatric Trauma cases per month (subjective)

◯ 1-5 ◯ 6-10 ◯ 11-25 ◯ 26-50 ◯ 51-75 ◯ 76-100
◯ 100-200 ◯ 201-300 ◯ 301-400 ◯ 401-500 ◯ <1

MVCs per month (subjective)

◯ 1-5 ◯ 6-10 ◯ 11-25 ◯ 26-50 ◯ 51-75 ◯ 76-100
◯ 100-200 ◯ 201-300 ◯ 301-400 ◯ 401-500 ◯ <1

Burns per month (subjective)

◯ 1-5 ◯ 6-10 ◯ 11-25 ◯ 26-50 ◯ 51-75 ◯ 76-100
◯ 100-200 ◯ 201-300 ◯ 301-400 ◯ 401-500 ◯ <1

Are all patients that come to the ED recorded in the log book?

◯ Yes ◯ No ◯ Don't know

Are all in-coming transfer patients recorded in the log book?

◯ Yes ◯ No ◯ Don't know

Are all out-going transfer patients recorded in the log book?

◯ Yes ◯ No ◯ Don't know

Explanation of Log Book entries

How do patients arrive to the Emergency Room (check all that apply)

☐ foot ☐ Motorcycle ☐ Taxi ☐ Private Vehicle
☐ Ambulance

How do patients most often arrive to the Emergency Room (select one)

◯ foot ◯ Motorcycle ◯ Taxi ◯ Private Vehicle
◯ Ambulance

INFRASTRUCTURE

What percent of the time do you have electricity?

Is the primary source city grid or generator?

What percent of the time is running water available?

What type of internet access is available? Percent of time operational?

Is this facility capable of patient transfers? ◯ Yes ◯ No

How are patients transferred? (check all that apply)

☐ foot ☐ car
☐ motorcycle ☐ private vehicle
☐ taxi ☐ ambulance

How are patients transferred most often? (check all that apply)

◯ foot ◯ car
◯ motorcycle ◯ private vehicle
◯ taxi ◯ ambulance

How many ambulances does the facility have?

What percentage of time is an ambulance available? (if available, get picture)

Are the ambulances shared?

What activities is the ambulance available for?

- ☐ pre-hospital care
- ☐ patient transfers
- ☐ Other

Who drives the ambulance?

What training do they have?

Does the ambulance have the following items?

Oxygen	◯ Yes	◯ No
IV equipment	◯ Yes	◯ No
Spine board	◯ Yes	◯ No
Ambu bag	◯ Yes	◯ No
Cervical collar	◯ Yes	◯ No
Fire extinguisher	◯ Yes	◯ No
Power inverter	◯ Yes	◯ No

Does the facility have a helicopter landing pad? ◯ Yes ◯ No

Is there somewhere nearby for a helicopter to land? How far away is it from the hospital?

Ambulance Notes

Are the following guidelines written and available on-site? Can we see them? (picture)

trauma guidelines	◯ Yes	◯ No
surgery guidelines	◯ Yes	◯ No
anesthesia guidelines	◯ Yes	◯ No

Explanation of Guidelines

QI Program

Are there QI mechanisms in place? ◯ Yes ◯ No

If yes, please explain:

Trauma Registry

Does this facility use a trauma registry? ◯ Yes ◯ No

If yes, does this information go to the MOH? ◯ Yes ◯ No

What parameters are in the trauma registry? (e.g. injury severity scale, GCS, mechanism of injury, location of injury)

In-Service Training

Does this facility offer in-service training? ◯ Yes ◯ No

If yes, who provides this training?

What topics have been covered?

How frequent are these trainings?

ATLS Training

Does this facility offer ATLS or equivalent trauma training? ◯ Yes ◯ No

If yes, who provides this training?

What topics have been covered?

How frequent are these trainings?

Does the facility have a dedicated area for trauma care? (If yes, picture) ◯ Yes ◯ No

Intensive Care Unit

Does this facility have an intensive care unit? (If yes, can we see it) ◯ Yes ◯ No

Who staffs the ICU and what is their training?

Is it staffed 24 hours a day? ◯ Yes ◯ No

Is it staffed 24 hours by a physician ◯ Yes ◯ No

If no, what hours is it staffed?

Is a physician available IN-HOUSE 24 hours? ◯ Yes ◯ No

If no, what hours is a doctor IN-HOUSE?

Is a physician available ON-CALL 24 hours? ◯ Yes ◯ No

If no, what hours is a doctor ON-CALL?

Answer the following questions with percent available, available but broken or not available:

Ventilators

Continuous cardiac monitoring

CVP monitoring

ICP monitoring

Compartment pressure monitoring

Blood Bank

Are blood products available? ◯ Yes ◯ No

Are blood products stored on-site? ◯ Yes ◯ No

Are they accessible 24/7? ◯ Yes ◯ No

Are they accessible immediately or is someone on-call? How long does it take to get them?

What percentage of time does the blood bank have blood?

What blood products are regularly available? (Check all that apply)

- ☐ packed RBCs
- ☐ platelets
- ☐ cryoprecipitate
- ☐ FFP

LABS

What percentage of time are the following labs available?

CBC	
Electrolytes	
Urinalysis	
Lactate	
Gram stain	
Bacterial culture	
Arterial blood gas	

Lab Notes

Are labs available nights and weekends ◯ Yes ◯ No

PERSONNEL

Is your ED open 24/7? ◯ Yes ◯ No

Is there an ED physician IN-HOUSE 24/7? ◯ Yes ◯ No

If no, what hours/days is one IN-HOUSE?

Is there an ED physician ON-CALL 24/7? ◯ Yes ◯ No

If no, what hours/days is one ON-CALL?

What training does this physician have? (e.g. internal medicine, family, EM)

What percentage of these physicians have ATLS or equivalent training?

What hours of the day is the ED staffed by a nurse?

Is there a wards physician IN-HOUSE 24/7? ◯ Yes ◯ No

If no, what hours is one IN-HOUSE?

Is there a wards physician ON-CALL 24/7? ◯ Yes ◯ No

If no, what hours is one ON-CALL?

Is there a general surgeon IN-HOUSE 24/7? ◯ Yes ◯ No

If no, what hours/days is one IN-HOUSE?

Is there a general surgeon ON-CALL 24/7? ◯ Yes ◯ No

If no, what hours/days is one ON-CALL?

What percentage of these physicians have ATLS or equivalent trauma training?

Is there an orthopedic surgeon IN-HOUSE 24/7? ◯ Yes ◯ No

If no, what hours/days is one IN-HOUSE?

Is there an orthopedic surgeon ON-CALL 24/7? ◯ Yes ◯ No

If no, what hours/days is one ON-CALL?

What percentage of these physicians have ATLS or equivalent trauma training?

Is there a neurological surgeon IN-HOUSE 24/7? ◯ Yes ◯ No

If no, what hours/days is one IN-HOUSE?

Is there a neurological surgeon ON-CALL 24/7? ◯ Yes ◯ No

If no, what hours/days is one ON-CALL?

What percentage of these physicians have ATLS or equivalent trauma training?

Is there an anesthesiologist IN-HOUSE 24/7? ◯ Yes ◯ No

If no, what hours/days is one IN-HOUSE?

Is there an anesthesiologist ON-CALL 24/7? ◯ Yes ◯ No

If no, what hours/days is one ON-CALL?

What percentage of these physicians have ATLS or equivalent trauma training?

Is there a nurse anesthetist IN-HOUSE 24/7? ◯ Yes ◯ No

If no, what hours/days is one IN-HOUSE?

Is there a nurse anesthetist ON-CALL 24/7? ◯ Yes ◯ No

If no, what hours/days is one ON-CALL?

What percentage of these physicians have ATLS or equivalent trauma training?

Are there OR staff IN-HOUSE 24/7? ◯ Yes ◯ No

If no, what hours/days is one IN-HOUSE?

Are there OR staff ON-CALL 24/7? ◯ Yes ◯ No

If no, what hours/days is one ON-CALL?

Is there physical therapy at this facility? ◯ Yes ◯ No

What percentage of time is PT available?

MACHINERY

What percentage of time are the following things available? (%, available but broken, not available)

Anesthesia machine

OR lights

Generator

Incinerator

Autoclave

EKG

Machinery Notes

SUPPLIES
What percentage of time are the following supplies available and where are they located in the hospital?

Vitals Equipment: percent of time available and location

Stethescope ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

BP cuff and sphyngmomanometer ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Pulse Oximeter ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Thermometer ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Airway/Breathing Equipment: percent of time available and location

Oxygen cylinder ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Portable Oxygen Source ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Oxygen concentrator ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Oxygen mask and tubing (nasal cannula, non-re-breather, etc) ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Suction (including pump, tubing, tip) ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Bag valve mask (adult) ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Bag valve mask (peds) ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

ET tubes (adult and peds) ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Laryngoscope (handle and blades) ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Ventilators ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Chest tube equipment ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Chest tube water seal suction equipment ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Cricothyrotomy equipment ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Circulatory Equipment: percent of time available and location

IV infusion equipment (including IV cannula various sizes, tubing) ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Butterfly needles ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

IO infusion equipment ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Central line equipment ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Crystalline fluids ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Colloid fluids (albumin, dextran, hetastarch) ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Fluid warmers ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Tourniquet ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Pelvic binder ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Head/Spine Equipment: percent of time available and location

Cervical collar ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Spine back board ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Burr hole drill ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Wheeled gurney ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Surgical Equipment: percent of time available and location

Scalpel ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Hemostat ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Needle driver ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Suture ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Straight scissors ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Retractor ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Laparotomy Equipment ◯ Yes ◯ No

OR (% time available)

Other (specify, % time available)

Thoracotomy equipment ◯ Yes ◯ No

OR (% time available)

Other (specify, % time available)

Vascular Equipment ◯ Yes ◯ No

OR (% time available)

Other (specify, % time available)

Neurosurgery Equipment ◯ Yes ◯ No

OR (% time available)

Other (specify, % time available)

External Fixation Equipment ◯ Yes ◯ No

OR (% time available)

Other (specify, % time available)

Internal Fixation Equipment ◯ Yes ◯ No

OR (% time available)

Other (specify, % time available)

C-section equipment ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Electrocautery ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Sterile drapes ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Face masks ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Eye protection ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Nail scrub brush ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Sterile patient preparation (iodine, chlohexidine) ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Sterile gloves ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Wound Care Supplies: percent of time available and location

Alcohol-based solution ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Non-sterile gloves ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Sterile dressing ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Clean non-sterile dressing ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Tape ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Miscellaneous Supplies: percent of time available and location

Splints ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Casting materials ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Vaginal speculum ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

NG tube ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Foley catheter ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Sharps container ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Flashlight ◯ Yes ◯ No

ED (% time available)

OR (% time available)

ICU (% time available)

Other (specify, % time available)

Medications: Percent of time available

Local anesthetics

General anesthetics	
Anxiolytics	
Opiates	
Vasopressors	
Anti-Hypertensives	
Anti-pyretics	
Anti-convulsants	
Anti-coagulants	
Paralytics	
Naloxone	
Diuretics	
Insulin	
Penicillin	
Cephalosporin	
Macrolides	
Fluoroquinolones	
Aminoglycosides	
Topical antibiotic ointment	
Normal saline	
Ringer's Lactate	
Glucose	
Albumin	
Sulfadiazine	
Magnesium	
Anti-fungals	
Topical anti-fungals	

Tetanus vaccine

Hepatits B Vaccine

Medication Notes

PROCEDURES
Number of procedures performed per month

Acute burn management

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

General Anesthesia

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Ketamine Anesthesia

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Spinal Anesthesia

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Resuscitation

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Cricothyrotomy

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Tracheotomy

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Foreign Body removal

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Laceration Repair

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Incision & Drainage of an abscess

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Wound debridement

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Chest tube insertion

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Splinting

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Casting

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Procedural treatment of a closed fracture

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Procedural treatment of an open fracture

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Amputation

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Skin grafting

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Laparotomy

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Thoracotomy

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

C-section

◯ 1-10 ◯ 11-25 ◯ 26-50 ◯ 51-75
◯ 76-100 ◯ 101+ ◯ Not available ◯ <1

Procedure Notes

IMAGING EQUIPMENT: Percentage of time available

CT Scanner

Portable X-Ray

Standing X-Ray

Ultrasound

Endoscopy

Angiography

Imaging Notes

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