Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____ _____

Jennifer Lee Pigoga, M.Sc Date

Assessing the impact of a low-cost WHO intervention package for emergency units in two hospitals in Uganda.

By

Jennifer Lee Pigoga, M.Sc

Master of Public

Global Epidemiology

_____

Dr Stephen Pitts

Committee Chair

_____

Dr Teri Reynolds

Committee Member

_____

Prof Lee Wallis

Committee Member

Assessing the impact of a low-cost WHO intervention package for emergency units in two hospitals in Uganda.

By

Jennifer Lee Pigoga

M.Sc., University of Cape Town, 2016

B.S., University of Rhode Island, 2015

B.A., University of Rhode Island, 2015

Thesis Committee Chair: Stephen Pitts, MD, MPH

An abstract of

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health

in Global Epidemiology

2018

Abstract

Assessing the impact of a low-cost WHO intervention package for

emergency units in two hospitals in Uganda.

By Jennifer Lee Pigoga, M.Sc

Objective

Emergency care is widely recognized as a cost- and time-effective means of reducing death and disability from a wide range of clinical presentations, yet there exists a lack of data surrounding context-appropriate emergency care interventions, particularly in low-resource areas. WHO created a set of simple process guidance documents and tools that can be implemented at very low cost to improve the delivery of emergency care without imposing additional resource requirements. These include: the WHO Basic Emergency Care short course, a consensus-based triage tool, trauma and medical care checklists, and process guidance for designating a resuscitation area for high-acuity patients. Our study sought to address the impact on early mortality of implementing these low-cost initiatives on key emergency conditions at two frontline hospital Emergency Units (EUs) in Uganda.

Methods

Thirteen months of pre-intervention data were collected on all patients presenting to the EUs of Kawolo General Hospital and Mubende Regional Referral Hospital with five key emergency conditions - pediatric diarrhea, pediatric pneumonia, road traffic accidents, postpartum hemorrhage, and asthma - using a standardized, tablet-based data abstraction form. The intervention package was then implemented over a period of seven days, after which the data collection continued.

In this interim analysis, and pre-intervention data and nine months of post intervention data were analyzed via regression to evaluate a primary outcome of 48-hour mortality.

Findings

We found that the implementation of a simplistic, low-cost package of emergency care interventions in EUs had significant, lasting effects on mortality associated with key emergency conditions. Kawolo saw a 74.3% relative reduction in mortality (2.33% to 0.60%, $p = 0.0205$), and Mubende, a 44.4% relative reduction (4.71% to 2.62%, $p = 0.0122$).

Conclusion

The intervention package has the potential to significantly reduce mortality due to conditions that are widely recognized as contributing to the high morbidity and mortality of acute disease, including mortality in vulnerable populations such as children under five years of age. Alongside demographic and burden of disease data also generated by the study, impact data can be used by policymakers, planners, and providers alike to inform future systems improvement initiatives and patient care.

Assessing the impact of a low-cost WHO intervention package for emergency units in two hospitals in Uganda.

By

Jennifer Lee Pigoga

M.Sc., University of Cape Town, 2016

B.S., University of Rhode Island, 2015

B.A., University of Rhode Island, 2015

Thesis Committee Chair: Stephen Pitts, MD, MPH

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health

in Global Epidemiology

2018

TITLE

Assessing the impact of a low-cost WHO intervention package for emergency units in two hospitals in Uganda.

INTRODUCTION

As a cross-cutting platform, emergency care provides life-saving recognition and resuscitation of, and referral for, severely ill and injured patients across a variety of settings. *Disease Control Priorities in Developing Countries* notes that an estimated 54% of all deaths in low-income countries (LICs) are amenable to emergency care (1). Many other studies also suggest that timely stabilization and resuscitation can decrease morbidity and mortality from a wide range of acute conditions, while also reducing strain on the healthcare system-at large (1-5). Largely due to its horizontal nature, it is often hard to characterize the impact that emergency care interventions have on patient outcomes. There has been little research conducted on the impact of emergency care implementation in LICs, hindering efforts to design effective and relevant systems and limiting progress towards achieving the Sustainable Development Goals (6).

Reductions in morbidity and mortality in LICs are hampered by the significant and largely unrecognized burden of acute disease coupled with a lack of dedicated emergency care systems. LICs suffer the highest rates maternal deaths from acute complications (7,8). Pediatric diarrhea alone causes nearly 1 million deaths per year (9), and 50% of pediatric deaths occur within 24 hours of arrival to hospitals (10). Noncommunicable diseases such as diabetes are also growing in prevalence. Without affordable access to consistent care, these patients often present to hospitals only when acutely ill, thus increasing their likelihood of death and chronic disability (7,8). Injuries also impact morbidity and mortality: 90% of injury-related deaths and 94% of disability-

adjusted life years due to injury occur in LICs (11,12). Yet, the burden of acute disease - encompassing both illness and injury - is severely under-documented LICs, particularly those in sub-Saharan Africa (13). There is also extremely limited evidence on the best way to deliver emergency care in LIC settings. What is known about these services is typically adapted from high-income countries, and is often ineffective and lacking context in LICs.

As a result of these gaps in data relating to both disease burden and effective interventions, emergency care is not a standardized component of most LIC healthcare systems (1), and advocacy plans to place emergency care on national and international agendas are minimal (14). Without interventions that are cost-effective and evidence-based, it is challenging to gain traction amongst stakeholders to recognize the potential impact that emergency care can have in reducing morbidity and mortality. Evidence is needed to guide policymakers and planners to decide the best way forward to integrate emergency health services into their system, so that patients can access affordable emergency care without delays (6).

Currently, emergency care in sub-Saharan Africa is mostly provided by individuals without focused training, on a first-come, first-served basis (14) . The temporal nature of service delivery means that priority is often not given to the most critical patients, and that emergency care is provided in a disseminated manner across several areas of the hospital. Timely emergency care can have a big impact on many conditions, and many interventions are simple and affordable. Simple improvements in organization and knowledge can have powerful effects, even where new material resources are not available. But, in order for these interventions to positively impact patient outcomes, they must be delivered in a systematic, organized fashion.

In response to this, WHO has created a set of simple process guidance documents and tools that can be implemented at very low cost to improve the delivery of emergency care, without imposing

additional resource requirements. These include: the WHO Basic Emergency Care (BEC) short course, a consensus-based triage tool, trauma and medical care checklists, and process guidance for designating a resuscitation area for high-acuity patients. The components of this intervention package are designed to be implemented over a seven-day period, with five days for the BEC course and two days for triage, checklists, and other process guidance training; this short course implementation method has been identified as a time-sensitive, cost-effective, and high-impact model for strengthening healthcare worker skills and knowledge, particularly in LICs (15).

The BEC course is intended for a wide range of frontline providers in low-resource settings, especially those staffing emergency units (EUs) of hospitals. The course teaches the basic elements of a general, systematic approach to care for any undifferentiated emergency patient, with an emphasis on caring for key presenting syndromes - difficulty breathing, shock, altered mental status and trauma - that are potentially life-threatening, long before a definitive diagnosis may be made. The final two days of implementation focus on the remaining process guidance elements. Participants learn how to best sort and prioritize patients by disease severity in the EU using the triage tool, so that the most critically ill and injured patients - those most likely to die or suffer disability - will be attended to by a trained provider first. They are instructed on how to use standardized medical and trauma care checklists as tools to help in the clinical care of any acute patient presenting for care at each facility. Finally, they receive critical EU process guidance, learning on how to set up an accessible and effective resuscitation area in their EU so that their most critical patients can be cared for in a timely manner. In addition to lectures and discussions, this portion of the training involves accessing the EU, if possible, so that guidance is site-specific and actively completed.

The package and its results are an opportunity to change the status quo of emergency care delivery across LIC EUs. In order to quantify potential impacts, WHO has developed a set of key

emergency conditions that are expected to be highly responsive to emergency care. Indicators were deemed to need to represent conditions with a high burden of disease, be in clinical areas often prioritized on the global health agenda, and be easily measurable. Injury, maternal and child health, and noncommunicable diseases were agreed upon to be the highest-priority clinical areas. Within these broad fields, five key emergency conditions were identified to serve as emergency care outcomes: pediatric diarrhea, pediatric pneumonia, road traffic accidents, postpartum hemorrhage, and asthma; these conditions were believed to be comprise a large burden of acute illness and injury in LICs and thus, be representative of the larger burden of acute disease (16, 17). For each key emergency condition, the primary metric to measure improvement in patient outcomes was determined to be mortality at 48-hours. The indicators were successfully pilot tested at at district-level hospitals in sub-Saharan African LICs to ensure that they were measurable and that the data points could be feasibly collected.

Our study sought to address the impact on early mortality of implementing these low-cost initiatives on key emergency conditions at two frontline hospital EUs in Uganda.

METHODS

A pre-post study design was employed primarily to evaluate patient mortality before and after the implementation of the intervention package.

Uganda, an East African LIC of 39.6 million (18), was chosen as the implementation country for numerous reasons: it is fairly typical of most LICs (19), there are strong national emergency care leads to help oversee the project, and WHO has a longstanding history of successful collaboration with the Ministry of Health. Uganda's healthcare status is poor. Many of its citizens are burdened with infectious and chronic diseases, such as HIV/AIDs, tuberculosis, malaria, and cardiovascular

disease. Injuries are increasing, as is maternal mortality. And, despite decreasing trends, infant and child mortality rates remain much higher than those seen in higher-income nations. Uganda is rapidly growing, but the healthcare system cannot keep up: the country faces severe shortages of healthcare providers across all cadres and insufficient medical infrastructure (19). Like nearly all LICs, there was much room for improving healthcare delivery in Uganda, but, unlike other LICs, the country was far enough along in starting to develop emergency care for the study to be successfully employed. Two frontline hospitals were selected by the in-country lead as study sites. Kawolo General Hospital is an XXX-bed hospital located 40 kilometers outside of Kampala and serves a total of 1.2 million people; Mubende Regional Referral Hospital is an XXX-bed hospital located 170 kilometers west of Kampala and has a catchment area of similar size (20).

At both sites, we monitored process and outcomes across the five previously-mentioned key emergency conditions, with the primary outcome being 48-hr mortality. A data abstraction form (Appendix 1) and relevant protocols to collect outcomes and process data, including basic demographics, information on presentation to and interventions received in the EU, and longitudinal hospital outcomes data. The form was provided to sites via a REDCap platform for data entry, with paper copies available if the need arose (e.g. power was down). REDCap (Research Electronic Data Capture; Vanderbilt University, Nashville, TN, USA) is a tablet-based application designed to support data capture for research studies; it provided a secure means of collecting data at both sites irrespective of consistent internet connect and data management on a server accessible to the research team (21). A full-time data collector was employed at each site and trained to follow the aforementioned protocol for abstracting data.

Approximately 13 months (February 2016 to March 2017) of standardized outcomes and process data were collected on all patients presenting with any of the five key emergency conditions to the two sites. The data collector reviewed all records of patients accessing EU care during this

timeframe to identify eligible cases; he or she then followed these patient records through to death, referral or discharge to continue abstracting all relevant data points.

In mid-March 2017, the WHO intervention package was implemented. Prior to trainings at each site, two WHO international trainers brought together three lead staff per site site - 1 clinical officer and 2 nursing officers - and trained them as intervention package trainers. Over the course of two days, the group was briefed on course content and equipped with skills pertaining to adult medical education, so they could later go on to teach the Toolkit trainings alongside WHO counterparts. Then, the training team, now comprised of two international trainers and the three local site trainers then trained 10 participants (2 doctors, 1 clinical officer, and 7 nurses) at Kawolo and 10 participants (1 doctor, 2 clinical officers, and 7 nurses) at Mubende. The course was administered to for all available and interested personnel that are clinicians currently working in site EUs. Each site then received a total of seven days training – five days for the BEC course and two days for triage, checklist training, and process guidance training. Pre-intervention data collection was stopped one week before the intervention at each site, and post-intervention data began one week after the training concluded at each site.

Three follow-up site visits were scheduled over the course of post-intervention period. During these visits, structured qualitative interviews were conducted to systematically discuss all factors that might be influencing EU and in-hospital care. Both open- and close-ended questions were used.

We intend to gather 13 months of post-implementation data at each site, with the data collection extending into April/May 2018 (site dependent). As an interim analysis, this study only includes the first nine months of post-intervention data (April 2017 to December 2017).

Data were exported from REDCap via encrypted .csv file, then cleaned and analysed using SAS 9.4 Software (© SAS, Cary, NC). All records with key emergency condition, date of presentation, and primary outcome were included for analysis. Basic and inferential statistics, including logistic regressions, were included in the output, with a the threshold for significance set to 0.05 for all inferential testing. All regressions were adjusted for time and day of presentation; condition-specific regressions were also adjusted for key sociodemographic covariates (age and gender).

This study was reviewed and approved by the Uganda Ministry of Health for Kawolo and Mubende Hospitals (Appendices 2 and 3), the University of Cape Town Human Research Ethics Committee (Appendix 4), the Emory University Institutional Review Board (Appendix 6), and the WHO Research Ethics Review Committee.

RESULTS

A total of 2346 patients presented with key emergency conditions during the 13-month pre-intervention study period: 1158 at Kawolo and 1188 at Mubende. During the 9-month post-intervention period, 1343 patients presented: 504 at Kawolo and 839 at Mubende. Age and gender distributions, both overall and by condition, are listed in Table 1. More patients were female (59.5%) and under the age of 18 (65.6%); however, age and gender distributions are dependent on condition.

Table 1: Demographics of study population.

Key emergency condition	Cases (n, %)	Age category distribution (n, %)				Gender distribution (n, %)			
		<1 yr	1 - <5 yrs	5 - <18 yrs	≥18 yrs	Missing	Male	Female	Missing
Pediatric diarrhea	915 (24.8)	45 (4.9)	610 (66.7)	253 (27.7)	0 (0.0)	7 (0.8)	472 (51.6)	412 (45.0)	31 (3.4)
Pediatric pneumonia	1202 (32.6)	48 (4.0)	891 (74.1)	251 (20.9)	0 (0.0)	12 (1.0)	660 (54.9)	504 (41.9)	38 (3.2)
Road traffic accident	1378 (37.4)	3 (0.2)	87 (6.3)	210 (15.2)	1068 (77.5)	10 (0.7)	1018 (73.9)	335 (24.3)	25 (1.8)
Postpartum hemorrhage	83 (2.3)	0 (0.0)	0 (0.0)	2 (2.4)	80 (96.4)	1 (1.2)	0 (0.0)	83 (100.0)	0 (0.0)
Asthma	111 (3.0)	1 (0.9)	2 (1.8)	23 (20.7)	83 (74.8)	2 (1.8)	44 (39.6)	66 (59.5)	1 (0.9)
All conditions	3689 (100.0)	97 (2.63)	1590 (43.1)	739 (20.0)	1231 (33.4)	32 (0.9)	1400 (37.9)	2194 (59.5)	95 (2.6)

Most patients were admitted to a hospital ward (73.7%), with higher admissions rates for pediatric conditions and lower admissions rates for all other conditions. Across all conditions, greater than two-thirds of patients arrived at the hospital via boda boda, taxi, or other paid transportation. Walk-ins were also common. Arrival in ambulances was very infrequent; this correlates with very low rates of referral from other healthcare facilities - less than 6% of patients presented via referral. Patients with road traffic injuries, postpartum hemorrhage, and asthma exacerbation tended to present to study sites within 48 hours of condition onset, while pediatric patients with diarrhea and pneumonia often presented well beyond 48 hours from onset (Table 2).

Table 2: Aggregate and referral-specific times from condition onset to presentation at study site.

Key emergency condition	Presentation	Time from condition onset to presentation at study site (n, %)				
		<1 day	1-<2 days	2-5 days	>5 days	Missing
Pediatric diarrhea	All patients	103 (29.7)	366 (40.0)	272 (29.7)	127 (13.9)	47 (5.1)
	Primary	100 (11.6)	360 (41.7)	259 (30.0	111 (12.9)	33 (3.8)
	Referred	3 (5.8)	6 (11.6)	13 (25.0)	16 (30.8)	14 (26.9)
Pediatric pneumonia	All patients	107 (8.9)	403 (33.5)	421 (35.0)	216 (18.0)	55 (4.6)
	Primary	106 (9.5)	388 (34.7)	400 (35.7)	187 (16.7)	39 (3.5)
	Referred	1 (1.2)	15 (18.3)	21 (25.6)	29 (35.4)	16 (19.5)
Road traffic accident	All patients	1241 (90.1)	50 (3.6)	15 (1.1)	9 (0.7)	63 (4.6)
	Primary	1204 (92.4)	38 (2.9)	6 (0.5)	6 (0.5)	49 (3.8)
	Referred	37 (49.3)	12 (16.0)	9 (12.0)	3 (4.0)	14 (18.7)
Postpartum hemorrhage	All patients	64 (77.1)	6 (7.2)	1 (1.2)	1 (1.2)	11 (13.3)
	Primary	54 (79.4)	4 (5.9)	0 (0.0)	1 (1.5)	9 (13.2)
	Referred	10 (66.7)	2 (13.3)	1 (6.7)	0 (0.0)	2 (13.3)
Asthma	All patients	77 (69.4)	22 (19.8)	2 (1.8)	4 (3.6)	6 (5.5)
	Primary	77 (70.0)	21 (19.1)	2 (1.8)	4 (3.6)	6 (5.5)
	Referred	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
All conditions	All patients	1592 (43.2)	847 (23.0)	711 (19.3)	357 (9.7)	182 (4.9)
	Primary	1541 (44.5)	811 (23.4)	667 (19.3)	309 (8.9)	136 (3.9)
	Referred	36 (16.0)	44 (19.6)	51 (22.7)	48 (21.3)	46 (20.4)

Across both sites, 48-hour mortality associated with key emergency conditions was 3.54% pre-intervention and 1.86% post-intervention, representing a significant relative reduction of 47.5% (Table 3). Overall site reductions in mortality were also significant. At Kawolo, the relative reduction was 74.3% (2.33% to 0.60%), while at Mubende, it was 44.4% (4.71% to 2.62%). Only one significant condition-specific reduction in mortality was seen: pediatric pneumonia, which was reduced by 54.7%.

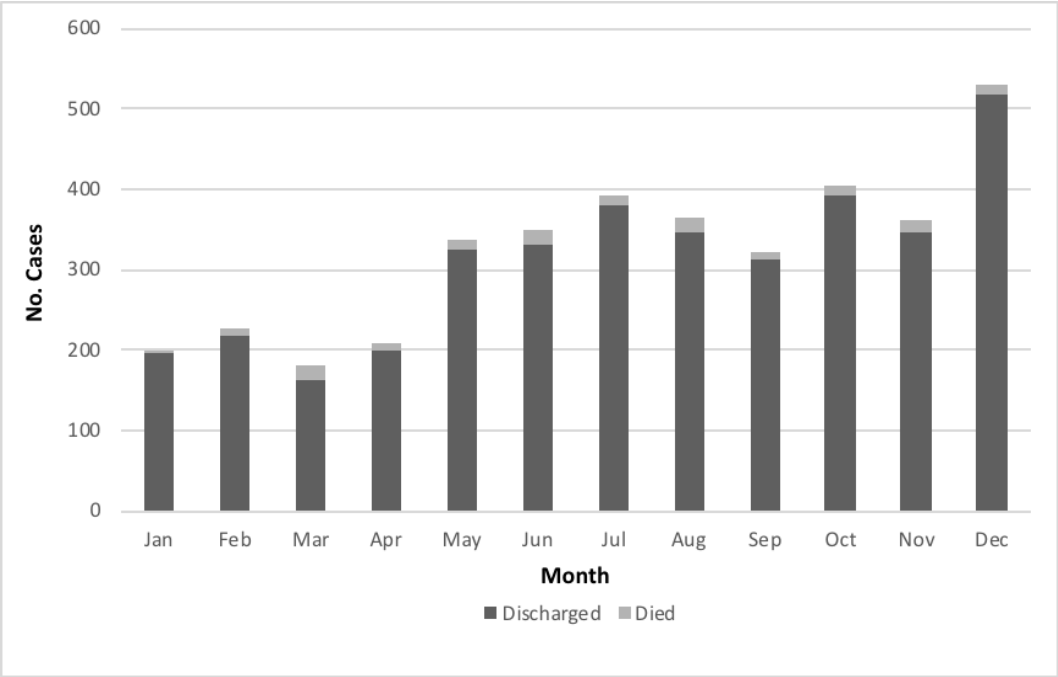
Table 3: Pre- and post-intervention site- and condition-specific case fatality rates.

Population	Pre-intervention		Post-intervention		Significance of 48-hour CFR		
	Patients (N)	48-hour CFR (%)	Patients (N)	48-hour CFR (%)	Odds ratio	95% confidence interval	p-value
All Uganda sites	2346	3.54%	1343	1.86%	0.5108	(0.3246, 0.8038)	0.0037
Kawolo	1158	2.33%	504	0.60%	0.2418	(0.0727, 0.8039)	0.0205
Mubende	1188	4.71%	839	2.62%	0.5255	(0.3176, 0.8693)	0.0122
Key emergency condition							
Pediatric diarrhea	628	2.87%	287	1.05%	0.6876	(0.1837, 2.5740)	0.5781
Pediatric pneumonia	706	6.23%	496	2.82%	0.4121	(0.2213, 0.7673)	0.0052
Road traffic accident	859	3.26%	519	1.54%	0.4739	(0.2111, 1.0637)	0.0702
Postpartum hemorrhage	60	1.67%	23	0.00%	0.0000	(0, 6.75E117)	0.9442
Asthma	93	1.08%	18	0.00%	0.0001	(0, 3.93E233)	0.9729

*CFR = Case Fatality Rate

December was associated with the greatest number of key emergency condition presentations across both sites, while March was associated with the highest CFR.

Figure 1: Distribution of key emergency condition presenters and associated case fatality, by month.



DISCUSSION

The study's primary aim - to evaluate package impact based on 48-hour CFRs - was achieved. Forty-eight-hour survival is commonly used in literature, as it is able to evaluate sustained survival due to early interventions (many of which occur in the EU) without excessive confounding from to other ward-based interventions and care. Although this interim analysis only includes 9 months of post-intervention data collection, the overall patient sample sizes were large enough to power significant reductions in mortality due to key emergency conditions across both study sites. This suggests that the reduction is likely an early effect in response to timely emergency care provided in EUs. While Kawolo experienced a larger relative reduction in mortality associated with key emergency conditions, Mubende's decrease was also significant, and is perhaps more important, as the site began with a much higher pre-intervention mortality rate than Kawolo.

The two key emergency conditions focusing on pediatric mortality - diarrhea and pneumonia - had the highest rates of admission to wards (89.2% and 87.1%, respectively). This, in combination with decreased likelihood of death at 48-hours, suggests that this critical group - comprised mainly of children under five years old - could strongly benefit from broader emergency care interventions. These patients also have much longer times to EU presentation than their counterparts in the study presenting with more obviously life-threatening conditions (asthma, postpartum hemorrhage, and road traffic accidents). Although it is typical for the onset-to-acuity time to be longer for the diarrheal diseases and pneumonia, these conditions are disproportionately affecting a vulnerable age group. No single in-hospital intervention can solve the matter of getting patients to present to EUs. Rather, this is an issue that must be addressed in the community via public health initiatives. Using this data to advocate for educational

programs on on early recognition and treatment of these conditions could be an effective means of getting these patients to EUs and further improving survival.

While not the primary focus of this study, simple demographic data can also be useful in informing future interventions and policies. For most conditions, age and gender presentations were as expected. For example, most road traffic accident patients were men (73.9%) during their most economic productive years. This aligns with historical data, much of which suggests that young adult men are disproportionately affected by morbidity and mortality due to road traffic accidents as countries undergo development (22, 23).

Few patients were referred, indicating that these hospitals are fulfilling their roles as frontline hospitals for emergency care provisions. As a prehospital system develops across Uganda, information on how patients are accessing EUs can be leveraged in decision making. Right now, very few people are being transported by ambulances; this is logical, as the country is currently only in the planning stages for a national ambulance system. Most patients are reaching EUs via paid transportation, such as in taxis. Layperson drivers are serving as first responders, but likely lack the knowledge and skills to provide rapid, life-saving interventions prior to transporting acutely ill and injured patients. In this scenario, a two-tier response prehospital system, with both layperson and professional responders, might be an ideal structure for prehospital emergency care.

The largest limitation of any pre- and post-intervention study is the potential for external factors to influence patient outcomes. For example, the construction of a new EU or implementation might improve access to care, or a new supply chain management program for the EU might improve availability of equipment to care for patients in a timely manner. To ensure that any of these factors would be identified, we scheduled three follow-up site visits over the course of post-

intervention period. During these visits, structured qualitative interviews are conducted to systematically capture any confounding factors that might be influencing EU and in-hospital care. Both open- and close-ended questions were used. Based on information collected from the two follow-up site visits that have occurred thus far, no other factors have been identified at Mubende and Kawolo that could have any large-scale impact on mortality.

Another limitation of our study structure is that it was a single-arm study, meaning that there was not a second arm that did not receive the intervention to serve as a control group. A cluster randomised controlled trial is the most ideal method of evaluating the intervention package; however, a study of that nature requires resources that were not feasible for this initial study.

Finally, because this was an interim analysis, the post-intervention data collection period is shorter than the pre-intervention period. Theoretically, this allows for seasonal variation to affect outcomes. But, since both wet and dry seasons are included in the outstanding months, it would be unlikely that the to influence the results in a single direction. The months that remain for analysis represent, in prior years, more low mortality months (January, February, and April) and only one high mortality month (March) and, overall, have a lower average mortality versus the rest of the year (10.5% versus 10.7%). Therefore, in any case, it is likely that our results are actually conservative: if anything, the inclusion of the additional four months could be expected to bring down the post-mortality (would make it a bit lower post mortality but not dramatically).

Overall, the results of this study lend support to the WHO EU intervention package. Both baseline and post-intervention data help to quantify the existing burdens of injury and illness in Uganda, and highlight the negative outcomes faced by those presenting with key emergency conditions. Epidemiologic data can also be leveraged to lobby policymakers and planners to invest in emergency care; however, they are not of much use on their own. This study's evidence

supporting the package's significant impacts on emergency care delivery and patient outcomes, when provided alongside robust burden of disease data, is likely to be a more effective means of encouraging investment. Results will allow these stakeholders to understand what the current situation is, and, more importantly, what are the most appropriate and effective solutions. From this, policymakers and planners can be better informed in their decision making at the system-level regarding the prioritisation of effective emergency care interventions in EUs nationwide.

The ideal study to evaluate this package is a cluster randomised controlled trial. We intend to seek funding to conduct this on a large, multi-country scale to further validate package impacts and understand translatability. In the interim, study results are being used to advocate for further rollout of the the package and its components across Uganda.

REFERENCES

1. Thind A, Hsia R, Mabweijano E, et al. Prehospital and Emergency Care. In: Essential Surgery. Disease Control Priorities in Developing Countries. Vol 1, 3 ed; 2015:246.
2. Ersdal HL, Mduma E, Svensen E, et al. Early initiation of basic resuscitation interventions including face mask ventilation may reduce birth asphyxia related mortality in low-income countries. *Resuscitation*. 2012;83(7):869–873.
3. Husum H, Gilbert M, Wisborg T, et al. Rural prehospital trauma systems improve trauma outcome in low-income countries: a prospective study from North Iraq and Cambodia. *J Trauma*. 2003;54(6):1188–1196.
4. Anderson PD, Suter RE, Mulligan T, et al. World Health Assembly Resolution 60.22 and its importance as a health care policy tool for improving emergency care access and availability globally. *Ann Emerg Med*. 2012;60(1):35-44.
5. Razzak JA, Kellermann AL. Emergency medical care in developing countries: is it worthwhile? *Bull World Heath Organ*. 2002; 80(11):900-905.
6. Reynolds TA,Barclay S, Drewqett I, et al. The Impact of Trauma Care Systems in Low- and Middle-Income Countries. *Annu Rev Public Health.* 2017.38:507-532
7. Mbugua PK, Otieno CF, Kayima JK, et al. Diabetic ketoacidosis: clinical presentation and precipitating factors at Kenyatta National Hospital, Nairobi. *East Afr Med J.* 2005; 82(12 Suppl):S191-196.
8. Desta T. Diabetic ketoacidosis in an Addis Ababa children's hospital. Ethiop. Med. J. 1992;30(1):7–11.

9. Walker CL, Rudan I, Liu L, et al. Global burden of childhood pneumonia and diarrhoea. Lancet. 2013;381(9875):1405-16.

10. Molyneux, E. Paediatric emergency care in developing countries. Lancet 2001; 357: 86-87.

11. Peden M, Sharma G. The injury chart book: a graphical overview of the global burden of injuries. Geneva: World Health Organization; 2002.

12. The global burden of disease: 2004 update. Geneva: World Health Organization; 2004. Accessed at: http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/

13. Holmes MD, Dalal S, Volmink J, et al. Non-communicable diseases in sub-Saharan Africa: the case for cohort studies. *PLoS Med.* 2010;7(5):e1000244.

14. Reynolds TA, Mfinanga JA, Sawe HR, et al. Emergency care capacity in Africa: a clinical and educational initiative in Tanzania. *J Public Health Policy*. 2012;33,Suppl 1:S126-37.

15. Pringle K, Mackey J, Ruskis J, et al. A Short Trauma Course for Physicians in a Resource-Limited Setting: Is Low-Cost Simulation Effective?. *Annals Emerg Med*. 2013; 62(4):S100.

16. Calvello EJ, Broccoli M, Risko N, et al. Emergency care and health systems: consensus-based recommendations and future research priorities. *Acad Emerg Med*. 2013;20(12):1278-88.

17. Mould-Millman NK, Naidoo R, de Vries S, et al. AFEM Consensus Conference, 2013. AFEM Out-of-Hospital Emergency Care Workgroup Consensus Paper: Advancing Out- of-Hospital Emergency Care in Africa - Advocacy and Development. *Afr J Emerg Med*. 4(2):90-5.

18. Central Intelligence Agency. Africa: Uganda – The World Factbook. Langley, Virginia: Central Intelligence Agency; 2013. Accessed at: https://www.cia.gov/library/publications/the-world-factbook/geos/ug.html

19. World Health Organization. Uganda: WHO Statistical Profile. Geneva: World Health Organization; 2013. Accessed at: http://www.who.int/gho/countries/uga.pdf?ua=1

20. Ministry of Health, Republic of Uganda. Hospitals. 2018. Accessed at: http://health.go.ug/affiliated-institutions/hospitals

21. Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (REDCap) – A metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377-81.

22. Sun JH, Wallis LA. The emergency first aid responder system model: using community members to assist life-threatening emergencies in violent, developing areas of need. *Emerg Med J*. 2012;29(8):673-8.

23. Hamber B, Lewis S. An Overview of the Consequences of Violence and Trauma in South Africa. South Africa: Centre for the Study of Violence and Reconciliation; 1997.

APPENDICES

APPENDIX 1: ECOP Data Collection Form

<table>
<tr><th colspan="6">DEMOGRAPHICS</th></tr>
<tr><td colspan="2">Age:</td><td colspan="2">Patient hospital number: Number on patient file folder</td><td colspan="2" rowspan="2">Chief complaint:
☐ Post-partum haemorrhage ☐ Asthma
☐ Road traffic accident ☐ Paediatric diarrhoea
☐ Paediatric pneumonia
☐ Other _____
Check “other” and write in chief complaint if not listed</td></tr>
<tr><td colspan="2">Sex: ☐ M ☐ F
☐ Unknown</td><td colspan="2">Study number in project: First two letters of hospital name, plus 4-digit patient number. Example: 211th patient recorded at Kawolo would be denoted KA0211</td></tr>
<tr><td colspan="3">Date of presentation (DD/MM/YY): Date that patient arrived at the EU</td><td colspan="3">Time of presentation: Time that patient arrived at EU (in 24 hour format)</td></tr>
<tr><td colspan="3">Date of injury or onset: Date that patient stated the symptoms began or injury occurred</td><td colspan="3">Time of injury on onset: Time that patient stated the symptoms began or injury occurred (in 24 hour format)</td></tr>
<tr><th colspan="6">CLINICAL</th></tr>
<tr><td colspan="3">Symptom-onset-to-arrival duration (days & hours)</td><td colspan="3" rowspan="2">Triaged? Was the patient triaged upon arrival to EU? ☐ Yes ☐ No
If yes, time: In 24 hour format
Level: ☐ Red ☐ Orange ☐ Yellow ☐ Green</td></tr>
<tr><td colspan="2">At primary facility: Complete only if patient has been transferred from another facility. Time elapsed between onset of symptoms and arrival to first facility.</td><td>At this facility: Time elapsed between onset of symptoms and arrival to first facility. For example, if a patient’s difficulty in breathing began on 28 Jan at 0700, but they did not seek care in the EU until 29 Jan at 0900, then they duration would be listed as 1 day 2 hours.</td></tr>
<tr><td colspan="3">If vitals recorded, for <u>first</u> set:</td><td colspan="3">Time of vitals: In 24 hour format</td></tr>
<tr><td>RR: In breaths per minute</td><td>BP: In mmHg</td><td>Temp: In °C</td><td>HR: In beats per minute</td><td>SpO2: % oxygen saturation</td><td>Other: List any additional vital signs</td></tr>
<tr><td colspan="6">In-hospital Interventions documented: Select all interventions taken in the EU.</td></tr>
<tr><th colspan="6">PROVIDER</th></tr>
<tr><td colspan="3">Highest level of care provided in emergency area:
Select the highest level of provider that saw the patient in the EU.</td><td colspan="3">Consult provider in emergency area:
Select all consultations the patient received from another hospital department while in the EU. Check “other” and write in consultant type if not listed.</td></tr>
<tr><th colspan="6">OUTCOMES</th></tr>
<tr><td colspan="3">Disposition from emergency area: Select where the patient went from the EU.</td><td colspan="3">Hospital Disposition: Select the outcome of the patients stay.</td></tr>
<tr><td colspan="3">Length of stay in high acuity area (days): Denote the number of days the patient spend in the ICU or high acuity unit. Round up to the nearest whole day.</td><td colspan="3">Length of stay in hospital (days): Denote the number of days, in total, that the patient stayed in all units of the hospital. Round up to the nearest whole day.</td></tr>
<tr><td>Final diagnosis - primary: List the ICD 9/10 code or hospital diagnosis.</td><td colspan="5">Final diagnosis -additional: List up to four secondary diagnoses. Use the ICD 9/10 codes or hospital diagnoses.</td></tr>
<tr><td colspan="6">Notes: Any additional information about the patient may be listed here.</td></tr>
</table>

APPENDIX 2: Ethical Approval – Uganda Ministry of Health for Mubende District Hospital

Telephones: General Lines: 231563/9
Permanent Secretary's Office: 340872
Fax: 256-41-231584
E-mail: ps@health.go.org
In any correspondence on this subject please quote
Ref no.ADM. 332/03

THE REPUBLIC OF UGANDA

Ministry of Health,
P. O. Box 7272,
Kampala,
Uganda

11th March 2016

The Director
Mubende Regional Referral Hospital
P.O.Box 4 Mubende

Dear Sir,

EMERGENCY CARE OUTCOMES INDICATORS ASSESSMENT

The World Health Organization (WHO) in collaboration with the African Federation for Emergency Medicine is carrying out an assessment of a WHO protocol for emergency care outcomes. The assessment of these indicators is to be carried out in 2 district hospitals in Uganda and in Tanzania. Mubende Regional Referral Hospital and Kawolo Hospital have been selected as the sites to carry out the assessment.

The data collected at the sites will focus on the types of emergency cases presenting to the Accidents & Emergency/ Casualty Units; the Out Patient Departments and the In Patient wards. Results from the assessment will guide the development of capacity of health facilities to provide emergency care and training needs in emergency medicine District/ Referral hospitals.

The data collectors were selected from a team that was successfully trained in the WHO Basic Emergency Care course as follows:

Mubende Hospital	Ms. Halima Adam
Kawolo Hospital	Mr. Jagwe Hakim

Please accord them with the necessary support towards the improvement of emergency medical care in Uganda.

APPENDIX 3: Ethical Approval – Uganda Ministry of Health for Mubende Regional Referral Hospital

Telephones: General Lines: 231563/9
Permanent Secretary's Office: 340872
Fax: 256-41-231584
E-mail: ps@health.go.org
In any correspondence on this subject please quote
Ref no.ADM. 332/03

THE REPUBLIC OF UGANDA

Ministry of Health,
P. O. Box 7272,
Kampala,
Uganda

7th March 2016

Cc. Director
Mubende Regional Referral Hospital

The Medical Superintendent
Kawolo Hospital

Dear Sir,

EMERGENCY CARE OUTCOMES INDICATORS ASSESSMENT

The World Health Organization (WHO) in collaboration with the African Federation for Emergency Medicine is carrying out an assessment of a WHO protocol for emergency care outcomes. The assessment of these indicators is to be carried out in 2 district hospitals in Uganda and in Tanzania. Mubende Regional Referral Hospital and Kawolo Hospital have been selected as the sites to carry out the assessment.

The data collected at the sites will focus on the types of emergency cases presenting to the Accidents & Emergency/Casualty Units; the Out Patient Departments and the In Patient wards. Results from the assessment will guide the development of capacity of health facilities to provide emergency care and training needs in emergency medicine District/Referral hospitals.

The data collectors were selected from a team that was successfully trained in the WHO Basic Emergency Care course as follows:

Mubende Hospital	Ms. Halima Adam
Kawolo Hospital	Mr. Jagwe Hakim

Please accord them with the necessary support towards the improvement of emergency medical care in Uganda.

APPENDIX 4: Ethical Approval – University of Cape Town Human Research Ethics Committee

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone [021] 406 6492
Email: sumayah.ariefdien@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

18 January 2017

HREC REF: 902/2016

Prof L Wallis
Division of Emergency Medicine
J-Floor
OMB

Dear Prof Wallis

PROJECT TITLE: WHO EMERGENCY CARE SYSTEMS OUTCOMES PROJECT

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study.

Approval is granted for one year until the 30 January 2018.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please quote the HREC REF in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval before the research may occur.

Yours sincerely

AN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938
This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (DoH

APPENDIX 5: Ethical Approval – Emory University Institutional Review Board

EMORY UNIVERSITY

Institutional Review Board

June 20, 2017

Jennifer Pigoga
Rollins School of Public Health

RE: Determination: No IRB Review Required
eIRB#: IRB00095228
Title: *The Emergency Care Outcomes Project*
PI: Jennifer Pigoga

Dear Jennifer:

Thank you for requesting a determination from our office about the above-referenced project. Based on our review of the materials you provided, we have determined that it does not require IRB review because it does not meet the definition of research with "human subjects" or "clinical investigation" as set forth in Emory policies and procedures and federal rules, if applicable. Specifically, in this project, you will receive previously de-identified pre- and post-intervention data collected for a WHO pilot study of emergency care and emergency care systems in sub-Saharan Africa. This project will specifically investigate differences in emergency patient outcomes as they relate to patient gender.

Please note that this determination does not mean that you cannot publish the results. This determination could be affected by substantive changes in the study design, subject populations, or identifiability of data. If the project changes in any substantive way, please contact our office for clarification.

Thank you for consulting the IRB.

Sincerely,

Emory University
1599 Clifton Road, 5th Floor - Atlanta, Georgia 30322
Tel: 404.712.0720 - Fax: 404.727.1358 - Email: irb@emory.edu - Web: http://www.irb.emory.edu
An equal opportunity, affirmative action university

APPENDIX 6: Ethical Approval – World Health Organization Research Ethics Review Committee

20, AVENUE APPIA – CH-1211 GENEVA 27 – SWITZERLAND – TEL CENTRAL +41 22 791 2111 – FAX CENTRAL +41 22 791 3111 – WWW.WHO.INT

Email: reynoldst@who.int

Tel. direct: +41 22 7913437

7 September 2016

To whom it may concern,

I am pleased to write in support of the Division of Emergency Medicine at the University of Cape Town collaboration on the World Health Organization (WHO) Emergency Care Outcomes Project. WHO has undertaken an assessment of emergency care outcomes indicators in four district/municipal level hospitals in Tanzania and Uganda as part of an emergency care quality improvement policy initiative.

We have requested that the Division of Emergency Medicine contribute to an analysis of this anonymized data. Data analysis responsibilities include:

- assessment of baseline indicators prior to the introduction of an essential emergency care training package, and
- comparison of these baseline data to post-intervention data that will be collected on the same clinical presentations immediately following the commencement of the training course at each site.

Professor Wallis has a well-established track record of successful collaboration with our programme, both in the development and implementation of a range of emergency care initiatives, and we look forward to working together on this project.

Yours sincerely,

Dr Teri Reynolds

Scientist

Emergency, Trauma and Acute Care Lead

Management of Noncommunicable Diseases, Disability, Violence and Injury Prevention (NVI)