BMJ Open

Emergency and urgent care capacity: an assessment of health facilities in western Kenya

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2014-006132
Article Type:	Research
Date Submitted by the Author:	16-Jul-2014
Complete List of Authors:	Burke, Thomas; Massachusetts General Hospital, Department of Emergency Medicine Hines, Rosemary; Massachusetts General Hospital, Department of Emergency Medicine Ahn, Roy; Massachusetts General Hospital, Department of Emergency Medicine Walters, Michelle; Massachusetts General Hospital, Department of Emergency Medicine Young, David; Massachusetts General Hospital, Department of Emergency Medicine Anderson, Rachel; Massachusetts General Hospital, Department of Emergency Medicine Tom, Sabrina; Massachusetts General Hospital, Department of Emergency Medicine Clark, Rachel; Massachusetts General Hospital, Department of Emergency Medicine Obita, Walter; Sagam Community Hospital, Nelson, Brett; Massachusetts General Hospital, Department of Emergency Medicine
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Global health
Keywords:	ACCIDENT & EMERGENCY MEDICINE, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, TRAUMA MANAGEMENT

Emergency and urgent care capacity in a resource-limited setting: an assessment of health facilities in western Kenya

Authors and affiliations

Thomas F. Burke, MD [a, b, c]

Rosemary Hines [a]

Roy Ahn, MPH, ScD [a, b, c]

Michelle Walters [a]

David Young, MD [a]

Rachel Eleanor Anderson, MD [a]

Sabrina Tom, MD [a]

Rachel Clark [a]

Walter Obita, MD [c]

Brett D. Nelson, MD, MPH [a, b, c]

a. Division of Global Health and Human Rights, Department of Emergency Medicine, Massachusetts General Hospital, Zero Emerson Place, Suite 104, Boston, MA 02114, USA

b. Harvard Medical School, 25 Shattuck St, Boston, MA 02115, USA

c. Sagam Community Hospital, Siaya Road, Luanda 50307, Kenya

Corresponding author:

Thomas F. Burke, MD, FACEP, FRSM

Division of Global Health and Human Rights, Massachusetts General Hospital

Zero Emerson Place, Suite 104, Boston, MA 02114, USA

E-mail tfburke@partners.org

Phone +1-617-584-0064

Word count:

2,919 words

Keywords:

Emergency medicine

Urgent care

Capacity assessment

Kenya

Pre-hospital care

Abstract

Objective: Injuries, trauma, and non-communicable diseases are responsible for a rising proportion of death and disability in low- and middle-income countries. Delivering effective emergency and urgent health care for these and other conditions in resource-limited settings is challenging. In this study, we sought to understand emergency and urgent care capacity in a resource-limited setting.

Methods: We conducted an assessment in western Kenya within all 30 primary and secondary hospitals and within a stratified random sampling of 30 dispensaries and health centers. Key informants were the most senior facility health care provider and manager available. Emergency physician researchers utilized a semi-structured assessment tool, and data were analyzed using descriptive statistics and thematic coding.

Results: No lower-level facilities and 30% of higher-level facilities reported having a defined, organized approach to trauma. Forty-three percent of higher-level facilities have access to an anesthetist. The majority of lower-level facilities have suture and wound care supplies and gloves but typically lack other basic trauma supplies. For cardiac care, 50% of higher-level facilities have morphine, but a minority have functioning ECG, sublingual nitroglycerin, or defibrillator. Only 20% of lower-level facilities have glucometers, and only 33% of higher-level facilities can care for diabetic emergencies. No facilities have sepsis clinical guidelines.

Conclusions: Large gaps in essential emergency care capabilities were identified at all facility levels in western Kenya. There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.

Strengths and limitations of this study:

- This assessment was completed within all 30 primary and secondary hospitals and a stratified random sampling of 30 dispensaries and health centers in western Kenya
- Semi-structured interviews were conducted among facility leadership to understand emergency and urgent care capacity in this resource-limited setting
- Large gaps at all facility levels were identified in essential care capabilities
- There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.
- The study may not be generalizable outside of this region.

Introduction

Background and importance

Providing effective emergency and urgent care is a considerable challenge in low- and middle-income countries. Difficulties exist with regard to transportation, communications, equipment, facility infrastructure, medication supply lines, affordability, and availability of skilled health care providers. Historically, infections caused by communicable diseases have been the major contributors to morbidity and mortality in resource-limited settings. However, traumatic injuries and non-communicable diseases (NCDs), such as heart disease and cancer, are rising rapidly and have recently become recognized as significant contributors to the burden of disease in developing countries. Eighty percent of all NCD deaths in 2008 (29 million) occurred in low- and middle-income countries, with cardiovascular disease, cancers, and respiratory disease the leading causes.[1] Furthermore, 16,000 people die globally each day from injuries alone, accounting for over 15% of the global burden of disease. Approximately 90% of these injuries occur in low- and middle-income countries.[2–4]

Kenya is facing an epidemic of NCDs and an increasing burden of injury and trauma. Between 2003 and 2008, the proportion of deaths related to trauma in western Kenya increased from 2.5% to 5·9%, with road traffic accidents (RTA) the leading cause.[5] In the past, most Kenya public health programs focused on communicable diseases. As a consequence, Kenya has developed disease-specific clinical guidelines for HIV/AIDS, malaria, tuberculosis, and other communicable diseases, but there are currently no national guidelines for emergency care.[6,7] As rates of NCDs and trauma-related injuries and deaths increase, there is a growing urgency to

provide adequate and organized treatment for time-sensitive illnesses and injuries, such as acute myocardial infarction, stroke, trauma, and sepsis.

Recent assessments performed in a select group of facilities in Nigeria, South Africa, and Tanzania documented emergency and critical care services in terms of resources, routines, and guidelines, while a small-scale evaluation of public emergency departments in Kenya described the most common diagnoses of presenting patients.[8–11] No assessment of the emergency care capabilities across a region in Kenya has ever been published.

Goals of this investigation

The Division of Global Health and Human Rights in the Department of Emergency Medicine at the Massachusetts General Hospital was approached by the Kenyan Ministry of Health and asked to assess the emergency and urgent health care capabilities across all levels of facilities in Kisumu and Siaya counties of western Kenya. This paper reports major findings from this assessment.

Health care provision in Kenya

Kenya has 6,626 health facilities across 47 counties, serving a population of over 43 million people. Kisumu and Siaya counties have populations of 968,909 (52% urban) and 842,304 (11% urban), respectively.[12,13] There are a total of 150 health facilities in Kisumu (92 public, 15 non-governmental, 15 faith-based, and 28 private) and a total of 162 health facilities in Siaya (115 public, 7 non-governmental, 17 faith-based, and 23 private). The Kenya Essential Package for

Health (KEPH) defines the levels of care in Kenya: Level 1 for community-administered care and Levels 2-6 for health care facilities (Table 1).[14] Levels 2, 3, 4, 5, and 6 represent dispensaries and clinics, health centers, primary hospitals, secondary hospitals, and tertiary hospitals, respectively.

Methods

Study design and setting

This facility-based emergency care capabilities assessment was conducted between November 1, 2013 and January 20, 2014, in Kisumu and Siaya counties in western Kenya. All 30 Level 4 and 5 facilities in the two counties (there are no Level 6 facilities in these counties) were selected for assessment. Selection of 30 additional facilities occurred via randomized stratified sampling of each additional type of facility – dispensary, health center, and health clinic. The criterion for inclusion was a fully functioning health facility; there were no restrictions based on geography or accessibility.

Methods and measurements

This facility-based emergency care capabilities assessment utilized semi-structured, key-informant interviews using a data collection instrument designed by the study authors. The key informants were the most senior institution staff members identified during the day of the assessment – typically the chief medical officer and/or senior administrator. The assessment tool drew from existing models of facility assessment in South Africa, Pakistan, and Tanzania, as well as the WHO Guidelines for Essential Trauma Care.[9,10,15,16] The assessment tool was refined

by expert consultation with the team's emergency physicians and public health epidemiologists, and covered eight domains: facility demographics, referral services, personnel, economics, supplies and laboratory, trauma, critical care, and anesthesia. The interviews consisted of open-response questions related to health care services, most common conditions of patients presenting for care, provider capabilities, equipment, supplies, and medications. Qualitative questions pertained to attitudes and perceptions related to provider morale, cooperation and communication between referring and receiving health facilities, and recommendations for continuing education and referral services.

The key-informant interviews were conducted by our field research team – consisting at all times of at least one emergency physician and one research assistant. Three different emergency physicians were involved throughout the data collection process. The delivery of questions and interview structure were discussed *a priori* by all three physician interviewers in order to standardize the interview process. Participants were provided an overview of the project, and the voluntary and confidential nature of the assessment was described. All participants gave verbal consent prior to participation.

Analysis

Data were analyzed using standard descriptive and frequency analyses, utilizing Microsoft Excel 2007 (Seattle, WA, USA). Qualitative research methods involved thematic analysis of interviews in order to best understand emergent findings.

Ethical review and funding

This study was reviewed and approved by the Institutional Review Board of Partners Healthcare (Boston, MA, USA) and the Ministry of Health of Kenya. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Results

A key informant at each of the 60 facilities was surveyed between November 1, 2013 and January 20, 2014. The facility sites were a mix of dispensaries/health clinics, health centers, primary hospitals, and secondary hospitals, as shown in Table 2. (There are no tertiary hospitals in Kisumu or Siaya County.) The 60 key informants comprised 10 chief medical officers (all at the hospital level), 39 nurse managers (facility matron), and 11 lead clinical officers.

Level 2 and 3 Facilities

Common Conditions

Key informants were asked to list the 10 most common emergent and urgent conditions presenting to their health facility. The most frequently reported conditions at Level 2 and 3 facilities were (in rank order) malaria (30/30, 100%), diarrhea (26/30, 87%), upper respiratory infections (24/30, 80%), skin infections (18/30, 60%), sexually transmitted infections (15/30, 50%), pneumonia (14/30, 47%), and RTAs/trauma (9/30, 30%).

Trauma and Injury

When asked if their Level 2 and 3 facilities have a specific approach to a trauma patient that differs from how they approach a medical patient, 0% of key informants answered in the affirmative. In response to how well respondents felt their facility can handle major trauma, all 30 said they refer. Twenty-six (87%) of the 30 said they refer immediately, and four (13%) said they try to provide first aid then refer. The majority of providers (21/30, 70%) said their facility is poorly equipped to handle a broken bone.

The majority of Level 2 and 3 facilities have suture and wound care supplies (26/30, 87%) and gloves (27/60, 90%) (Table 3). Few of these facilities have oxygen (7/30, 23%) and splinting/casting supplies (3/30, 10%), and none have blood for transfusion (0/30, 0%).

Critical Care

When asked about the standard procedure for treating someone with a possible heart attack, all 30 providers at Level 2 and 3 facilities reported that their facility refers. Eighteen (60%) of the 30 reported referring patients immediately, eight (27%) said they treat symptoms (e.g., painkillers, oxygen) and then refer, and four (13%) said they check vitals and then refer. Of the 30 Level 2 and 3 facilities, one has sublingual nitroglycerin.

The majority of providers (29/30, 93%) at the lower-level facilities said that their facility is ill-prepared to handle possible diabetic ketoacidosis (DKA) and must refer all cases. Overall, six (20%) Level 2 and 3 facilities have a glucometer and five (17%) have insulin.

In regards to a standard procedure for cases of possible sepsis, fifteen (50%) of the 30 providers at Level 2 and 3 facilities said they refer, 11 (37%) reported providing treatment without referral (e.g., antibiotics, IV fluids), and four (13%) providers said that they did not know how to approach sepsis. A majority of the Level 2 and 3 facilities (24/30, 80%) have antibiotics.

Facility Levels 4 and 5

Common Conditions

The most frequently reported presenting emergent and urgent conditions at Level 4 and 5 facilities were similar to those at Level 2 and 3 facilities. They are (in rank order): malaria (30/30, 100%), diarrhea (22/30, 73%), sexually transmitted infections (21/30, 70%), pneumonia (21/30, 70%), RTAs/trauma (18/30, 60%), and upper respiratory infections (16/30, 53%).

Trauma and Injury

Nine (30%) providers at Level 4 and 5 facilities reported that their facility has an organized approach to trauma (e.g., emergency team with assembly point). When asked if they are notified in advance of patients arriving to the hospital, four (13%) answered in the affirmative.

In review of basic trauma supplies in Level 4 and 5 facilities, 97% have gloves, 93% have suture and wound care materials, and 83% have oxygen. All five of the Level 5 facilities have chest tubes and x-ray capability, and four of the five have splinting and casting supplies. Three (12%) of the 25 Level 4 facilities have chest tubes and 12 (48%) have x-ray capability. Sixteen (64%) of the 25 Level 4 facilities, and all five of the Level 5 facilities have blood available for transfusion.

Seventeen (57%) providers at Level 4 and 5 facilities reported that their facility does not have access to a trained provider that can administer general or regional anesthesia.

Critical Care

When asked about diagnosis and treatment of someone presenting with a possible acute myocardial infarction (AMI), 20 (80%) of 25 providers at level 4 hospitals reported that their facility refers; 11 (44%) reported that their facility stabilizes (e.g., oxygen or first aid) and then refers, and nine (30%) providers reported that their facility refers immediately. Five (20%) providers at Level 4 facilities reported that their facility provides diagnostic and treatment services without referral (e.g., ACE inhibitors, beta blockers, or aspirin). All 5 Level 5 facilities reported giving oxygen to suspected AMI patients, while three reported providing aspirin, two reported providing morphine and one reported providing epinephrine. Several of the Level 4 and 5 facilities were lacking in supplies and equipment to manage cardiac emergencies. Fifteen (50%) facilities have morphine, six (20%) have a functioning ECG machine, six (20%) have nitroglycerin, and four (13%) have a defibrillator.

Ten (33%) of 30 providers at Level 4 and 5 facilities reported that their facility is well-prepared to manage DKA. A majority of Level 4 and 5 facilities have a glucometer (28/30, 93%) and insulin (24/30, 80%).

When asked about a standard procedure for cases of sepsis, the vast majority (29/30, 97%) of Level 4 and 5 facilities reported providing some treatment for sepsis (e.g., antibiotics, IV fluids),

but none had standardized clinical care guidelines. Twenty-three (92%) of the 25 Level 4 and all five of the Level 5 facilities have vasopressor agents. Twenty-two (88%) of the 25 Level 4 and all five of the Level 5 facilities have antibiotics.

Discussion

With an increasing number of NCDs, RTAs, and other time-sensitive illnesses and injuries, the provision of emergency care in low-and middle-income countries is taking on increasing importance. Our study illustrates that essential emergency and urgent care is severely lacking in western Kenya. Limited communication, infrastructure, supplies, and properly trained human resources all negatively impact the ability to deliver quality emergency and urgent health care.

Although by definition Level 2 and Level 3 facilities in Kenya are not designed nor expected to provide comprehensive care for acutely ill patients, we elected to study their capabilities around emergency care since community members often present to them with acute life-threatening illnesses and injuries. We discovered that virtually all of the 30 Level 2 and 3 facilities we studied were unable to respond to the essential needs of patients presenting with acute trauma, a possible heart attack, diabetic emergencies, or sepsis. Most facilities reported transferring patients without even basic assessments or interventions. Few facilities had any organized approach in transferring a patient or notifying the receiving facility.

The authors view the Level 2 and 3 facility findings as a compelling call to action for the development of a contextually appropriate, standardized basic level training and materials

package for emergency care. For example, a training program in the essentials of emergency care for Level 2 and 3 facilities should include the development of a standard approach to all acute care patients: basic assessment and intervention of airway, breathing, and circulation; taking and interpreting vital signs; methodical total body assessment; hemorrhage control; immobilization and splinting of potential injuries; capabilities of providing basic high-impact diagnostics and interventions (e.g., point-of-care glucose, ECG, aspirin, antibiotics, splints); and a pre-established reliable and rapid referral and notification plan.

While emergent and urgent conditions present frequently to Level 4 and 5 facilities, we discovered that the hospitals' capabilities varied considerably. While all of the 30 facilities had gaps across each of the domains we studied, many of the gaps at the Level 4 facilities were quite profound. Overall, some of the more salient findings in the Level 4 and 5 facilities' assessments were: 70% do not have a standardized approach to trauma, few have the basic materials necessary to manage trauma (e.g. chest tube, blood), less than half have a functioning x-ray machine, less than half (43%) of the operating theatres have access to an anesthetist, only six of 30 have EKG machines or nitroglycerin, most do not give aspirin for heart attacks, few are able to provide care for DKA, and no facility had a standardized approach to sepsis.

The findings from our Level 4 and Level 5 facility assessment demonstrate an urgent need for a system-wide intervention, targeting the unmet higher-level facility needs of the acutely ill and injured. Many of the Level 4 and 5 facilities do not meet the most basic standard for the essentials of emergency care delivery that we believe can – and should – be universally

implemented at all lower-level facilities. We propose that in addition to every facility being brought up to the basic level, a second package in essentials of advanced emergency care should be developed and deployed to select Level 4 and 5 facilities. These selected facilities, once meeting standards for training, materials, and infrastructure, should then be designated and widely recognized and supported as *centers of excellence for advanced emergency care*, and thereby capable of providing quality assessment and initial stabilization of all emergent and urgent conditions.

Access to quality pre-hospital care services was universally poor in our study sample and can be seen as an opportunity for organization and improvement. A basic pre-hospital system should be created by establishing a mechanism to access reliable transportation staffed with personnel who have basic life-support skills. Elsewhere, it has been shown that training lay people in the community, such as community health workers or public transportation drivers to function as pre-hospital care providers, can greatly improve the quality of emergency care.[17] Additionally, a standardized communication method ought to be instituted. For example, in Sierra Leone, it has been shown that equipping remote health facilities and traditional birth attendants with radio receivers linked to referral hospitals can shorten response times and reduce maternal deaths.[18]

Although not addressed in this study, it is likely that these findings would be similar elsewhere across sub-Saharan Africa. If this assessment is indeed generalizable, the authors believe that the development of a set of standardized packages for basic and advanced essentials of

emergency care in low-resource settings, as well as designating *centers of excellence for advanced emergency care,* should be a priority for the WHO and other stakeholders.

Our study had several limitations. Although we believe the lessons learned are representative of counties in Kenya and other low-resource settings globally, our findings are not definitively generalizable beyond the two counties surveyed. Furthermore, we recognize that elements of our survey may have been limited by social desirability bias. Although we tried to mitigate this with the anonymous nature of our survey and by explaining the purpose of our study, participants may not have felt comfortable reporting problems or inadequacies in their facilities. While our research staff included a local Kenyan who was present at all site visits and functioned as a language and cultural ambassador, language and cultural differences may have contributed to confounding variables. Furthermore, while informants were selected based on their senior leadership roles and expertise with the operations of their facility, their responses might not have always accurately reflected opinions of the majority of providers at the facility.

In conclusion, with an increasing epidemic of NCDs and an increasing burden of injury and trauma in low-resource areas, access to quality essential emergency and urgent care services is critical for the health of surrounding communities. Our 60-facility assessment in western Kenya identified significant widespread gaps in current emergency care capabilities, particularly in identifying and appropriately caring for victims of trauma, acute myocardial infarction, diabetic emergencies, and sepsis. There is great opportunity for development of a universally deployed basic package in the essentials of emergency care, a selectively implemented package in the

essentials of advanced emergency care, a center of excellence for emergency care facility designation scheme, and a reliable pre-hospital care transportation and communications system. Additionally, the profound gap in readily available trained anesthetists requires immediate attention.

Table 1: Description of levels of care in Kenya

Level 1	Community	- Care outside facility in households, communities, and villages - Maximum population served: 5,000
Level 2	Dispensaries/ Clinics	- Has limited staff (nurses, public health technicians, and assistants) - Responsible for community engagement through curative, promotive, preventive, and rehabilitative care at a basic level - Up to four beds for observation - Maximum population served: 10,000(rural) - 15,000(urban)
Level 3	Health Centers	- Staffed by nurses, clinical officers, and occasionally doctors - Wider range of curative and preventive services than Level 2 - Provide minor surgical services, like incision and drainage - Basic emergency preparedness - 12-49 beds - Maximum population served: 30,000-40,000
Level 4	Primary Hospitals	- Provide referral level outpatient care, curative and preventive care, surgical treatment techniques, and comprehensive emergency services - Provide clinical services in obstetrics and gynecology, child health, medicine, and surgery and anesthesia - Inpatient care and 24-hour service - Minimum 50 beds - Maximum population served: 100,000(rural) - 200,000(urban)

Level 5-6	Secondary/ Tertiary Hospitals	- Higher concentration of resources and personnel (medical professionals, nurses, and midwives) - Provide clinical services in medicine, general surgery and anesthesia, pediatrics, and obstetrics/gynecology, dental, psychiatry, comprehensive accident and emergency, ENT, ophthalmology, dermatology, ICU - Minimum 50 beds - Maximum population served: 1,000,000

Table 2: Health facilities studied in Kisumu and Siaya counties in Kenya; November 2013-January 2014

Type of Health Facility	Kisumu	Siaya	Total
Dispensary/Health Clinic (Level 2)	9	12	**21**
Health Center (Level 3)	6	3	**9**
Primary Hospitals (Level 4)	18	6	**25**
Secondary Hospitals (Level 5)	4	1	**5**
Total	**38**	**22**	**60**

Table 3: Functioning supplies and equipment at health facilities in Kisumu and Siaya, Kenya (number of facilities)

	Level 2 n=21 (%)	Level 3 n=9 (%)	Level 4 n=25 (%)	Level 5 n=5 (%)	Total n=60 (%)
General					
Gloves	20 (95)	7 (78)	24 (96)	5 (100)	56 (93)
Face masks	10 (48)	4 (44)	21 (84)	5 (100)	40 (67)
Gowns	3 (14)	4 (44)	17 (68)	5 (100)	29 (48)
Monitored beds	NA	NA	1 (4)	4 (80)	6 (10)
Central line kits	NA	NA	1 (4)	4 (80)	5 (8)
Suction	5 (24)	4 (44)	19 (76)	4 (80)	32 (53)
Blood pressure cuffs	18 (86)	6 (67)	23 (92)	5 (100)	52 (87)
Splint/cast supplies	2 (10)	1 (11)	14 (56)	4 (80)	21 (35)
Suture and wound-care supplies	18 (86)	8 (89)	23 (92)	5 (100)	54 (90)
Defibrillator	1 (5)	0 (0)	1 (4)	3 (60)	5 (8)
Back-up power	1 (5)	2 (22)	14 (56)	5 (100)	22 (42)
Chest tube trays	1 (5)	1 (11)	3 (12)	5 (100)	10 (17)

Laboratory/Diagnostics					
Ultrasound	1 (5)	0 (0)	9 (36)	5 (100)	15 (25)
ECG	0 (0)	1 (11)	3 (12)	3 (60)	8 (13)
X-ray	1 (5)	0 (0)	12 (48)	5 (100)	18 (30)
Otoscope	5 (24)	4 (44)	14 (56)	5 (100)	28 (47)
Ophthalmoscope	4 (19)	4 (44)	13 (52)	5 (100)	26 (43)
Glucometer	3 (14)	3 (33)	23 (92)	5 (100)	34 (57)
Medications					
Nitroglycerin	0 (0)	1 (11)	4 (16)	2 (40)	7 (12)
Antibiotics	16 (76)	8 (89)	22 (88)	5 (100)	51 (85)
Opiates	0 (0)	0 (0)	10 (40)	5 (100)	15 (25)
Insulin	4 (19)	1 (11)	19 (76)	5 (100)	29 (48)
Pressors	NA	NA	23 (92)	5 (100)	48 (80)
General and regional anesthesia	NA	NA	8 (32)	5 (100)	13 (22)
Airway/Breathing					
Oxygen	5 (24)	2 (22)	20 (80)	5 (100)	32 (53)

CPAP/BPAP machine	NA	NA	0 (0)	1 (20)	1 (2)
Ambubag	8 (38)	1 (11)	20 (80)	5 (100)	34 (57)
Intubation supplies	2 (10)	4 (44)	12 (48)	5 (100)	23 (38)

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. This study was funded internally and by in-kind donation by the authors' Division of Global Health and Human Rights at Massachusetts General Hospital.

Competing interests:

All of the authors have been formally queried, and no authors have competing interests with this study.

Data sharing statement: Extra data are available by emailing tfburke@partners.org.

Author contributions:

TFB was involved in study design, implementation, analysis, and writing of the manuscript. RA was involved in study analysis and writing of the manuscript. RA was involved in study design, implementation, analysis, and writing of the manuscript. MW, DY, REA, ST, RC, and WO were involved in study design and data collection. BDN was involved in study design, implementation, analysis, and writing of the manuscript. All authors have reviewed, edited, and approved the final submission. TFB takes responsibility for the paper as a whole.

References

1 World Health Organization. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization, 2010.

2 Peden M, McGee K, Sharma G. The injury chartbook: A graphical overview of the global burden of injuries. Geneva: World Health Organization, 2002.

3 Gosselin R, Spiegel D, Coughlin R, et al. Injuries: the neglected burden in developing countries. *Bulletin of the World Health Organization* 2009; **87**:246.

4 Mock C, Lormand JD, Goosen J, et al. Guidelines for essential trauma care. Geneva: World Health Organization, 2004.

5 Odhiambo FO, Beynon CM, Ogwang S, et al. Trauma-related mortality among adults in rural western Kenya: Characterising deaths using data from a health and demographic surveillance system. *PLoS ONE* 2013; **8**(11):e79840.

6 Ministry of Health, Government of Kenya. Guidelines for antiretroviral drug therapy in Kenya. 2011. Available at: http://www.who.int/hiv/pub/guidelines/kenya_art.pdf. Accessed 7 May 2014.

7 Ministry of Public Health and Sanitation. Guidelines on management of leprosy and tuberculosis. 2009. Available at: http://www.who.int/hiv/pub/guidelines/kenya_tb.pdf. Accessed 7 May 2014.

8 Baker T, Lugazia E, Eriksen J, et al. Emergency and critical care services in Tanzania: A survey of ten hospitals. *BMC Health Services Research* 2013; **13**:140.

9 Wallis LA, Garach SR, Kropman A. State of emergency medicine in South Africa. *Int J Emerg Med* 2008; **1**(2):69–71.

10 Wen LS, Oshiomogho JI, Eluwa GI, et al. Characteristics and capabilities of emergency departments in Abuja, Nigeria. *Emerg Med J* 2012; **29**(10):798–801.

11 Wachira BW, Wallis LA, Geduld H. An analysis of the clinical practice of emergency medicine in public emergency departments in Kenya. *Emerg Med J* 2012; **29**(6):473–6.

12 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/ Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

13 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/ Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

14 Luoma M, Doherty J, Muchiri S, et al. August 2010. *Kenya Health System Assessment* 2010. Bethesda, MD: Health Systems 20/20 project, Abt Associates Inc.

15 World Health Organization. Guidelines for essential trauma care. Geneva, World Health Organization, 2004.

16 Razzak JA, Hyder AA, Akhtar T, et al. Assessing emergency medical care in low-income countries: A pilot study from Pakistan. *BMC Emergency Medicine* 2008; **8**:8.

17 Mock CN, Tiska M, Adu-Ampofo M, et al. Improvements in prehospital trauma care in an African country with no formal emergency medical services. *J Trauma* 2002; **53**(1): 90–7.

18 Samai O, Senegeh P. Facilitating emergency obstetrical care through transportation and communication, Bo, Sierra Leone. *International Journal of Gynecology and Obstetrics* 1997; 59 Suppl **2**:S157–64.

Manuscript: Emergency and urgent care capacity: an assessment of health facilities in western Kenya

Thomas F. Burke, et al.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	DONE	PAGE
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	X	1, 5
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	X	5
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	X	6-8
Objectives	3	State specific objectives, including any prespecified hypotheses	X	8
Methods				
Study design	4	Present key elements of study design early in the paper	X	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	X	8-10
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	X	9-10
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	X	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	X	9
Bias	9	Describe any efforts to address potential sources of bias	X	17-18
Study size	10	Explain how the study size was arrived at	N/A	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	N/A	N/A
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	X	9-10
		(*b*) Describe any methods used to examine subgroups and	N/A	N/A

		interactions		
		(*c*) Explain how missing data were addressed	N/A	N/A
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	N/A	N/A
		(*e*) Describe any sensitivity analyses	N/A	N/A
Results			**DONE**	**PAGE**
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	X	10
		(b) Give reasons for non-participation at each stage	N/A	N/A
		(c) Consider use of a flow diagram	N/A	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	X	10, 22
		(b) Indicate number of participants with missing data for each variable of interest	N/A	N/A
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)	N/A	N/A
Outcome data	15*	Cohort study—Report numbers of outcome events or summary measures over time	N/A	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	X	23-25
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A	N/A
		(b) Report category boundaries when continuous variables were categorized	N/A	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	X	9
Discussion				
Key results	18	Summarise key results with reference to study objectives	X	14-15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	X	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	X	15-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	X	17
Other information				

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	X	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Emergency and urgent care capacity in a resource-limited setting: an assessment of health facilities in western Kenya

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2014-006132.R1
Article Type:	Research
Date Submitted by the Author:	02-Sep-2014
Complete List of Authors:	Burke, Thomas; Massachusetts General Hospital, Department of Emergency Medicine Hines, Rosemary; Massachusetts General Hospital, Department of Emergency Medicine Ahn, Roy; Massachusetts General Hospital, Department of Emergency Medicine Walters, Michelle; Massachusetts General Hospital, Department of Emergency Medicine Young, David; Massachusetts General Hospital, Department of Emergency Medicine Anderson, Rachel; Massachusetts General Hospital, Department of Emergency Medicine Tom, Sabrina; Massachusetts General Hospital, Department of Emergency Medicine Clark, Rachel; Massachusetts General Hospital, Department of Emergency Medicine Obita, Walter; Sagam Community Hospital, Nelson, Brett; Massachusetts General Hospital, Department of Emergency Medicine
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Global health
Keywords:	ACCIDENT & EMERGENCY MEDICINE, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, TRAUMA MANAGEMENT

Emergency and urgent care capacity in a resource-limited setting: an assessment of health facilities in western Kenya

Authors and affiliations

Thomas F. Burke, MD [a, b, c]

Rosemary Hines [a]

Roy Ahn, MPH, ScD [a, b, c]

Michelle Walters [a]

David Young, MD [a]

Rachel Eleanor Anderson, MD [a]

Sabrina Tom, MD [a]

Rachel Clark [a]

Walter Obita, MD [c]

Brett D. Nelson, MD, MPH [a, b, c]

a. Division of Global Health and Human Rights, Department of Emergency Medicine, Massachusetts General Hospital, Zero Emerson Place, Suite 104, Boston, MA 02114, USA

b. Harvard Medical School, 25 Shattuck St, Boston, MA 02115, USA

c. Sagam Community Hospital, Siaya Road, Luanda 50307, Kenya

Corresponding author:

Thomas F. Burke, MD, FACEP, FRSM

Division of Global Health and Human Rights, Massachusetts General Hospital

Zero Emerson Place, Suite 104, Boston, MA 02114, USA

E-mail tfburke@partners.org

Phone +1-617-584-0064

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. This study was funded internally and by in-kind donation by the authors' Division of Global Health and Human Rights at Massachusetts General Hospital.

Competing interests:

All of the authors have been formally queried, and no authors have competing interests with this study.

Word count:

2,953 words

Keywords:

Emergency medicine

Urgent care

Capacity assessment

Kenya

Pre-hospital care

Abstract

Objective: Injuries, trauma, and non-communicable diseases are responsible for a rising proportion of death and disability in low- and middle-income countries. Delivering effective emergency and urgent health care for these and other conditions in resource-limited settings is challenging. In this study, we sought to examine and characterize emergency and urgent care capacity in a resource-limited setting.

Methods: We conducted an assessment in western Kenya within all 30 primary and secondary hospitals and within a stratified random sampling of 30 dispensaries and health centers. Key informants were the most senior facility health care provider and manager available. Emergency physician researchers utilized a semi-structured assessment tool, and data were analyzed using descriptive statistics and thematic coding.

Results: No lower-level facilities and 30% of higher-level facilities reported having a defined, organized approach to trauma. Forty-three percent of higher-level facilities have access to an anesthetist. The majority of lower-level facilities have suture and wound care supplies and gloves but typically lack other basic trauma supplies. For cardiac care, 50% of higher-level facilities have morphine, but a minority have functioning ECG, sublingual nitroglycerin, or defibrillator. Only 20% of lower-level facilities have glucometers, and only 33% of higher-level facilities can care for diabetic emergencies. No facilities have sepsis clinical guidelines.

Conclusions: Large gaps in essential emergency care capabilities were identified at all facility levels in western Kenya. There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.

Strengths and limitations of this study:

- This assessment was completed within all 30 primary and secondary hospitals and a stratified random sampling of 30 dispensaries and health centers in western Kenya
- Semi-structured interviews were conducted among facility leadership to examine and characterize emergency and urgent care capacity in this resource-limited setting
- Large gaps at all facility levels were identified in essential care capabilities
- There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.
- The study may not be generalizable outside of this region.

Introduction

Background and importance

Providing effective emergency and urgent care is a considerable challenge in low- and middle-income countries. Difficulties exist with regard to transportation, communications, equipment, facility infrastructure, medication supply lines, affordability, and availability of skilled health care providers. Historically, infections caused by communicable diseases have been the major contributors to morbidity and mortality in resource-limited settings. However, traumatic injuries and non-communicable diseases (NCDs), such as heart disease and cancer, are rising rapidly and have recently become recognized as significant contributors to the burden of disease in developing countries. Eighty percent of all NCD deaths in 2008 (29 million) occurred in low- and middle-income countries, with cardiovascular disease, cancers, and respiratory disease the leading causes.[1] Furthermore, 16,000 people die globally each day from injuries alone, accounting for over 15% of the global burden of disease. Approximately 90% of these injuries occur in low- and middle-income countries.[2–4]

Kenya is facing an epidemic of NCDs and an increasing burden of injury and trauma. Between 2003 and 2008, the proportion of deaths related to trauma in western Kenya increased from 2.5% to 5·9%, with road traffic accidents (RTA) the leading cause.[5] In the past, most Kenya public health programs focused on communicable diseases. As a consequence, Kenya has developed disease-specific clinical guidelines for HIV/AIDS, malaria, tuberculosis, and other communicable diseases, but there are currently no national guidelines for emergency care.[6,7] As rates of NCDs and trauma-related injuries and deaths increase, there is a growing urgency to

provide adequate and organized treatment for time-sensitive illnesses and injuries, such as acute myocardial infarction, stroke, trauma, and sepsis.

Recent assessments performed in a select group of facilities in Nigeria, South Africa, and Tanzania documented emergency and critical care services in terms of resources, routines, and guidelines, while a small-scale evaluation of public emergency departments in Kenya described the most common diagnoses of presenting patients.[8–11] Other facility-level studies in Kenya have assessed inpatient care.[12,13] However, no assessment of the emergency care capabilities across a region in Kenya has ever been published.

Goals of this investigation

The Division of Global Health and Human Rights in the Department of Emergency Medicine at the Massachusetts General Hospital was approached by the Kenyan Ministry of Health and asked to assess the emergency and urgent health care capabilities across all levels of facilities in Kisumu and Siaya counties of western Kenya. This paper reports major findings from this assessment.

Health care provision in Kenya

Kenya has 6,626 health facilities across 47 counties, serving a population of over 43 million people. Kisumu and Siaya counties have populations of 968,909 (52% urban) and 842,304 (11% urban), respectively.[14,15] There are a total of 150 health facilities in Kisumu (92 public, 15 non-governmental, 15 faith-based, and 28 private) and a total of 162 health facilities in Siaya (115

public, 7 non-governmental, 17 faith-based, and 23 private). The Kenya Essential Package for Health (KEPH) defines the levels of care in Kenya: Level 1 for community-administered care and Levels 2-6 for health care facilities (Table 1).[16] Levels 2, 3, 4, 5, and 6 represent dispensaries and clinics, health centers, primary hospitals, secondary hospitals, and tertiary hospitals, respectively.

Methods

Study design and setting

This facility-based emergency care capabilities assessment was conducted between November 1, 2013 and January 20, 2014, in Kisumu and Siaya counties in western Kenya. All 30 Level 4 and 5 facilities in the two counties (there are no Level 6 facilities in these counties) were selected for assessment. Selection of 30 additional facilities occurred via randomized stratified sampling of each additional type of facility – dispensary, health center, and health clinic. The criterion for inclusion was an open healthcare facility currently providing health services; there were no restrictions based on geography or accessibility.

Methods and measurements

This facility-based emergency care capabilities assessment utilized semi-structured, key-informant interviews using a data collection instrument designed by the study authors. The key informants were the most senior institution staff members identified during the day of the assessment – typically the chief medical officer and/or senior administrator. The assessment tool drew from existing models of facility assessment in South Africa, Pakistan, and Tanzania, as

well as the WHO Guidelines for Essential Trauma Care.[9,10,17,18] The assessment tool was refined by expert consultation with the team's emergency physicians and public health epidemiologists, and covered eight domains: facility demographics, referral services, personnel, economics, supplies and laboratory, trauma, critical care, and anesthesia. The interviews consisted of open-response questions related to health care services, most common conditions of patients presenting for care, provider capabilities, equipment, supplies, and medications. Qualitative questions pertained to attitudes and perceptions related to provider morale, cooperation and communication between referring and receiving health facilities, and recommendations for continuing education and referral services.

The key-informant interviews were conducted by our field research team – consisting at all times of at least one emergency physician and one research assistant. Three different emergency physicians were involved throughout the data collection process. The delivery of questions and interview structure were discussed *a priori* by all three physician interviewers in order to standardize the interview process. Participants were provided an overview of the project, and the voluntary and confidential nature of the assessment was described. All participants gave verbal consent prior to participation.

Analysis

Data were analyzed using standard descriptive and frequency analyses, utilizing Microsoft Excel 2007 (Seattle, WA, USA). Qualitative research methods involved thematic analysis of interviews in order to best understand emergent findings.

Ethical review and funding

This study was reviewed and approved by the Institutional Review Board of Partners Healthcare (Boston, MA, USA) and the Ministry of Health of Kenya. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Results

A key informant at each of the 60 facilities was surveyed between November 1, 2013 and January 20, 2014. The facility sites were a mix of dispensaries/health clinics, health centers, primary hospitals, and secondary hospitals, as shown in Table 2. (There are no tertiary hospitals in Kisumu or Siaya County.) The 60 key informants comprised 10 chief medical officers (all at the hospital level), 39 nurse managers (facility matron), and 11 lead clinical officers.

Level 2 and 3 Facilities

Common Conditions

Key informants were asked to list the 10 most common emergent and urgent conditions presenting to their health facility. The most frequently reported conditions at Level 2 and 3 facilities were (in rank order) malaria (30/30, 100%), diarrhea (26/30, 87%), upper respiratory infections (24/30, 80%), skin infections (18/30, 60%), sexually transmitted infections (15/30, 50%), pneumonia (14/30, 47%), and RTAs/trauma (9/30, 30%).

Trauma and Injury

When asked if their Level 2 and 3 facilities have a specific approach to a trauma patient that differs from how they approach a medical patient, 0% of key informants answered in the affirmative. In response to how well respondents felt their facility can handle major trauma, all 30 said they refer. Twenty-six (87%) of the 30 said they refer immediately, and four (13%) said they try to provide first aid then refer. The majority of providers (21/30, 70%) said their facility is poorly equipped to handle a broken bone.

The majority of Level 2 and 3 facilities have suture and wound care supplies (26/30, 87%) and gloves (27/60, 90%) (Table 3). Few of these facilities have oxygen (7/30, 23%) and splinting/casting supplies (3/30, 10%), and none have blood for transfusion (0/30, 0%).

Critical Care

When asked about the standard procedure for treating someone with a possible heart attack, all 30 providers at Level 2 and 3 facilities reported that their facility refers. Eighteen (60%) of the 30 reported referring patients immediately, eight (27%) said they treat symptoms (e.g., painkillers, oxygen) and then refer, and four (13%) said they check vitals and then refer. Of the 30 Level 2 and 3 facilities, one has sublingual nitroglycerin.

The majority of providers (29/30, 93%) at the lower-level facilities said that their facility is ill-prepared to handle possible diabetic ketoacidosis (DKA) and must refer all cases. Overall, six (20%) Level 2 and 3 facilities have a glucometer and five (17%) have insulin.

In regards to a standard procedure for cases of possible sepsis, fifteen (50%) of the 30 providers at Level 2 and 3 facilities said they refer, 11 (37%) reported providing treatment without referral (e.g., antibiotics, IV fluids), and four (13%) providers said that they did not know how to approach sepsis. A majority of the Level 2 and 3 facilities (24/30, 80%) have antibiotics.

Facility Levels 4 and 5

Common Conditions

The most frequently reported presenting emergent and urgent conditions at Level 4 and 5 facilities were similar to those at Level 2 and 3 facilities. They are (in rank order): malaria (30/30, 100%), diarrhea (22/30, 73%), sexually transmitted infections (21/30, 70%), pneumonia (21/30, 70%), RTAs/trauma (18/30, 60%), and upper respiratory infections (16/30, 53%).

Trauma and Injury

Nine (30%) providers at Level 4 and 5 facilities reported that their facility has an organized approach to trauma (e.g., emergency team with assembly point). When asked if they are notified in advance of patients arriving to the hospital, four (13%) answered in the affirmative.

In review of basic trauma supplies in Level 4 and 5 facilities, 97% have gloves, 93% have suture and wound care materials, and 83% have oxygen. All five of the Level 5 facilities have chest tubes and x-ray capability, and four of the five have splinting and casting supplies. Three (12%) of the 25 Level 4 facilities have chest tubes and 12 (48%) have x-ray capability. Sixteen (64%) of the 25 Level 4 facilities, and all five of the Level 5 facilities have blood available for transfusion.

Seventeen (57%) providers at Level 4 and 5 facilities reported that their facility does not have access to a trained provider that can administer general or regional anesthesia.

Critical Care

When asked about diagnosis and treatment of someone presenting with a possible acute myocardial infarction (AMI), 20 (80%) of 25 providers at level 4 hospitals reported that their facility refers; 11 (44%) reported that their facility stabilizes (e.g., oxygen or first aid) and then refers, and nine (30%) providers reported that their facility refers immediately. Five (20%) providers at Level 4 facilities reported that their facility provides diagnostic and treatment services without referral (e.g., ACE inhibitors, beta blockers, or aspirin). All 5 Level 5 facilities reported giving oxygen to suspected AMI patients, while three reported providing aspirin, two reported providing morphine and one reported providing epinephrine. Several of the Level 4 and 5 facilities were lacking in supplies and equipment to manage cardiac emergencies. Fifteen (50%) facilities have morphine, six (20%) have a functioning ECG machine, six (20%) have nitroglycerin, and four (13%) have a defibrillator.

Ten (33%) of 30 providers at Level 4 and 5 facilities reported that their facility is well-prepared to manage DKA. A majority of Level 4 and 5 facilities have a glucometer (28/30, 93%) and insulin (24/30, 80%).

When asked about a standard procedure for cases of sepsis, the vast majority (29/30, 97%) of Level 4 and 5 facilities reported providing some treatment for sepsis (e.g., antibiotics, IV fluids),

but none had standardized clinical care guidelines. Twenty-three (92%) of the 25 Level 4 and all five of the Level 5 facilities have vasopressor agents. Twenty-two (88%) of the 25 Level 4 and all five of the Level 5 facilities have antibiotics.

Discussion

With an increasing number of NCDs, RTAs, and other time-sensitive illnesses and injuries, the provision of emergency care in low-and middle-income countries is taking on increasing importance. Our study illustrates that essential emergency and urgent care is severely lacking in western Kenya. Limited communication, infrastructure, supplies, and properly trained human resources all negatively impact the ability to deliver quality emergency and urgent health care.

Although by definition Level 2 and Level 3 facilities in Kenya are not designed nor expected to provide comprehensive care for acutely ill patients, we elected to study their capabilities around emergency care since community members often present to them with acute life-threatening illnesses and injuries. We discovered that virtually all of the 30 Level 2 and 3 facilities we studied were unable to respond to the essential needs of patients presenting with acute trauma, a possible heart attack, diabetic emergencies, or sepsis. Most facilities reported transferring patients without even basic assessments or interventions. Few facilities had any organized approach in transferring a patient or notifying the receiving facility.

The authors view the Level 2 and 3 facility findings as a compelling call to action for the development of a contextually appropriate, standardized basic level training and materials

package for emergency care. For example, a training program in the essentials of emergency care for Level 2 and 3 facilities should include the development of a standard approach to all acute care patients: basic assessment and intervention of airway, breathing, and circulation; taking and interpreting vital signs; methodical total body assessment; hemorrhage control; immobilization and splinting of potential injuries; capabilities of providing basic high-impact diagnostics and interventions (e.g., point-of-care glucose, ECG, aspirin, antibiotics, splints); and a pre-established reliable and rapid referral and notification plan.

While emergent and urgent conditions present frequently to Level 4 and 5 facilities, we discovered that the hospitals' capabilities varied considerably. While all of the 30 facilities had gaps across each of the domains we studied, many of the gaps at the Level 4 facilities were quite profound. Overall, some of the more salient findings in the Level 4 and 5 facilities' assessments were: 70% do not have a standardized approach to trauma, few have the basic materials necessary to manage trauma (e.g. chest tube, blood), less than half have a functioning x-ray machine, less than half (43%) of the operating theatres have access to an anesthetist, only six of 30 have EKG machines or nitroglycerin, most do not give aspirin for heart attacks, few are able to provide care for DKA, and no facility had a standardized approach to sepsis.

The findings from our Level 4 and Level 5 facility assessment demonstrate an urgent need for a system-wide intervention, targeting the unmet higher-level facility needs of the acutely ill and injured. Many of the Level 4 and 5 facilities do not meet the most basic standard for the essentials of emergency care delivery that we believe can – and should – be universally

implemented at all lower-level facilities. We propose that in addition to every facility being brought up to the basic level, a second package in essentials of advanced emergency care should be developed and deployed to select Level 4 and 5 facilities. These selected facilities, once meeting standards for training, materials, and infrastructure, should then be designated and widely recognized and supported as *centers of excellence for advanced emergency care*, and thereby capable of providing quality assessment and initial stabilization of all emergent and urgent conditions.

Access to quality pre-hospital care services was universally poor in our study sample and can be seen as an opportunity for organization and improvement. A basic pre-hospital system should be created by establishing a mechanism to access reliable transportation staffed with personnel who have basic life-support skills. Elsewhere, it has been shown that training lay people in the community, such as community health workers or public transportation drivers to function as pre-hospital care providers, can greatly improve the quality of emergency care.[19] Additionally, a standardized communication method ought to be instituted. For example, in Sierra Leone, it has been shown that equipping remote health facilities and traditional birth attendants with radio receivers linked to referral hospitals can shorten response times and reduce maternal deaths.[20]

Although not addressed in this study, it is likely that these findings would be similar elsewhere across sub-Saharan Africa. If this assessment is indeed generalizable, the authors believe that the development of a set of standardized packages for basic and advanced essentials of

emergency care in low-resource settings, as well as designating *centers of excellence for advanced emergency care,* should be a priority for the WHO and other stakeholders. The African Federation for Emergency Medicine has been developing consensus recommendations for emergency care packages for various facility levels.[21]

Our study had several limitations. Although we believe the lessons learned are representative of counties in Kenya and other low-resource settings globally, our findings are not definitively generalizable beyond the two counties surveyed. Furthermore, we recognize that elements of our survey may have been limited by social desirability bias. Although we tried to mitigate this with the confidential and voluntary nature of our survey and by explaining the purpose of our study, participants may not have felt comfortable reporting problems or inadequacies in their facilities. While our research staff included a local Kenyan who was present at all site visits and functioned as a language and cultural ambassador, language and cultural differences may have contributed to confounding variables. Furthermore, while informants were selected based on their senior leadership roles and expertise with the operations of their facility, their responses might not have always accurately reflected opinions of the majority of providers at the facility.

In conclusion, with an increasing epidemic of NCDs and an increasing burden of injury and trauma in low-resource areas, access to quality essential emergency and urgent care services is critical for the health of surrounding communities. Our 60-facility assessment in western Kenya identified significant widespread gaps in current emergency care capabilities, particularly in identifying and appropriately caring for victims of trauma, acute myocardial infarction, diabetic

emergencies, and sepsis. There is great opportunity for development of a universally deployed basic package in the essentials of emergency care, a selectively implemented package in the essentials of advanced emergency care, a center of excellence for emergency care facility designation scheme, and a reliable pre-hospital care transportation and communications system. Additionally, the profound gap in readily available trained anesthetists requires immediate attention.

Author contributions:

TFB was involved in study design, implementation, analysis, and writing of the manuscript. RA was involved in study analysis and writing of the manuscript. RA was involved in study design, implementation, analysis, and writing of the manuscript. MW, DY, REA, ST, RC, and WO were involved in study design and data collection. BDN was involved in study design, implementation, analysis, and writing of the manuscript. All authors have reviewed, edited, and approved the final submission. TFB takes responsibility for the paper as a whole.

Funding: This work was supported by Division of Global Health and Human Rights, Massachusetts General Hospital

Competing Interests: None

Data sharing statement: No additional data available

References

1 World Health Organization. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization, 2010.

2 Peden M, McGee K, Sharma G. The injury chartbook: A graphical overview of the global burden of injuries. Geneva: World Health Organization, 2002.

3 Gosselin R, Spiegel D, Coughlin R, et al. Injuries: the neglected burden in developing countries. *Bulletin of the World Health Organization* 2009; **87**:246.

4 Mock C, Lormand JD, Goosen J, et al. Guidelines for essential trauma care. Geneva: World Health Organization, 2004.

5 Odhiambo FO, Beynon CM, Ogwang S, et al. Trauma-related mortality among adults in rural western Kenya: Characterising deaths using data from a health and demographic surveillance system. *PLoS ONE* 2013; **8**(11):e79840.

6 Ministry of Health, Government of Kenya. Guidelines for antiretroviral drug therapy in Kenya. 2011. Available at: http://www.who.int/hiv/pub/guidelines/kenya_art.pdf. Accessed 7 May 2014.

7 Ministry of Public Health and Sanitation. Guidelines on management of leprosy and tuberculosis. 2009. Available at: http://www.who.int/hiv/pub/guidelines/kenya_tb.pdf. Accessed 7 May 2014.

8 Baker T, Lugazia E, Eriksen J, et al. Emergency and critical care services in Tanzania: A survey of ten hospitals. *BMC Health Services Research* 2013; **13**:140.

9 Wallis LA, Garach SR, Kropman A. State of emergency medicine in South Africa. *Int J Emerg Med* 2008; **1**(2):69–71.

10 Wen LS, Oshiomogho JI, Eluwa GI, et al. Characteristics and capabilities of emergency departments in Abuja, Nigeria. *Emerg Med J* 2012; **29**(10):798–801.

11 Wachira BW, Wallis LA, Geduld H. An analysis of the clinical practice of emergency medicine in public emergency departments in Kenya. *Emerg Med J* 2012; **29**(6):473–6.

12 Mwaniki P, Ayieko P, Todd J, et al. Assessment of paediatric inpatient care during a multifaceted quality improvement intervention in Kenyan district hospitals: Use of prospectively collected case record data. *BMC Health Serv Res* 2014; **14**:312.

13 Irimu GW, Gathara D, Zurovac D, et al. Performance of health workers in the management of seriously sick children at a Kenyan tertiary hospital: Before and after a training intervention. *PLoS One* 2012; **7**(7):e39964.

14 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/ Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

15 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/ Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

16 Luoma M, Doherty J, Muchiri S, et al. August 2010. *Kenya Health System Assessment* 2010. Bethesda, MD: Health Systems 20/20 project, Abt Associates Inc.

17 World Health Organization. Guidelines for essential trauma care. Geneva, World Health Organization, 2004.

18 Razzak JA, Hyder AA, Akhtar T, et al. Assessing emergency medical care in low-income countries: A pilot study from Pakistan. *BMC Emergency Medicine* 2008; **8**:8.

19 Mock CN, Tiska M, Adu-Ampofo M, et al. Improvements in prehospital trauma care in an African country with no formal emergency medical services. *J Trauma* 2002; **53**(1): 90–7.

20 Samai O, Senegeh P. Facilitating emergency obstetrical care through transportation and communication, Bo, Sierra Leone. *International Journal of Gynecology and Obstetrics* 1997; 59 Suppl **2**:S157–64.

21 Calvello E, Reynolds T, Hirshon JM, et al. Emergency care in sub-Saharan Africa: Results of a consensus conference. *African Journal of Emergency Medicine* 2013; **3**(1): 42–8.

Table 1: Description of levels of care in Kenya

Level 1	Community	- Care outside facility in households, communities, and villages - Maximum population served: 5,000
Level 2	Dispensaries/ Clinics	- Has limited staff (nurses, public health technicians, and assistants) - Responsible for community engagement through curative, promotive, preventive, and rehabilitative care at a basic level - Up to four beds for observation - Maximum population served: 10,000(rural) - 15,000(urban)
Level 3	Health Centers	- Staffed by nurses, clinical officers, and occasionally doctors - Wider range of curative and preventive services than Level 2 - Provide minor surgical services, like incision and drainage - Basic emergency preparedness - 12-49 beds - Maximum population served: 30,000-40,000
Level 4	Primary Hospitals	- Provide referral level outpatient care, curative and preventive care, surgical treatment techniques, and comprehensive emergency services - Provide clinical services in obstetrics and gynecology, child health, medicine, and surgery and anesthesia - Inpatient care and 24-hour service - Minimum 50 beds - Maximum population served: 100,000(rural) - 200,000(urban)

Level 5-6	Secondary/ Tertiary Hospitals	- Higher concentration of resources and personnel (medical professionals, nurses, and midwives) - Provide clinical services in medicine, general surgery and anesthesia, pediatrics, and obstetrics/gynecology, dental, psychiatry, comprehensive accident and emergency, ENT, ophthalmology, dermatology, ICU - Minimum 50 beds - Maximum population served: 1,000,000

Table 2: Health facilities studied in Kisumu and Siaya counties in Kenya; November 2013-January 2014

Type of Health Facility	Kisumu	Siaya	Total
Dispensary/Health Clinic (Level 2)	9	12	**21**
Health Center (Level 3)	6	3	**9**
Primary Hospitals (Level 4)	18	6	**25**
Secondary Hospitals (Level 5)	4	1	**5**
Total	**38**	**22**	**60**

Table 3: Functioning supplies and equipment at health facilities in Kisumu and Siaya, Kenya (number of facilities)

	Level 2 n=21 (%)	Level 3 n=9 (%)	Level 4 n=25 (%)	Level 5 n=5 (%)	Total n=60 (%)
General					
Gloves	20 (95)	7 (78)	24 (96)	5 (100)	56 (93)
Face masks	10 (48)	4 (44)	21 (84)	5 (100)	40 (67)
Gowns	3 (14)	4 (44)	17 (68)	5 (100)	29 (48)
Monitored beds	NA	NA	1 (4)	4 (80)	6 (10)
Central line kits	NA	NA	1 (4)	4 (80)	5 (8)
Suction	5 (24)	4 (44)	19 (76)	4 (80)	32 (53)
Blood pressure cuffs	18 (86)	6 (67)	23 (92)	5 (100)	52 (87)
Splint/cast supplies	2 (10)	1 (11)	14 (56)	4 (80)	21 (35)
Suture and wound-care supplies	18 (86)	8 (89)	23 (92)	5 (100)	54 (90)
Defibrillator	1 (5)	0 (0)	1 (4)	3 (60)	5 (8)
Back-up power	1 (5)	2 (22)	14 (56)	5 (100)	22 (42)
Chest tube trays	1 (5)	1 (11)	3 (12)	5 (100)	10 (17)

Laboratory/Diagnostics					
Ultrasound	1 (5)	0 (0)	9 (36)	5 (100)	15 (25)
ECG	0 (0)	1 (11)	3 (12)	3 (60)	8 (13)
X-ray	1 (5)	0 (0)	12 (48)	5 (100)	18 (30)
Otoscope	5 (24)	4 (44)	14 (56)	5 (100)	28 (47)
Ophthalmoscope	4 (19)	4 (44)	13 (52)	5 (100)	26 (43)
Glucometer	3 (14)	3 (33)	23 (92)	5 (100)	34 (57)
Medications					
Nitroglycerin	0 (0)	1 (11)	4 (16)	2 (40)	7 (12)
Antibiotics	16 (76)	8 (89)	22 (88)	5 (100)	51 (85)
Opiates	0 (0)	0 (0)	10 (40)	5 (100)	15 (25)
Insulin	4 (19)	1 (11)	19 (76)	5 (100)	29 (48)
Pressors	NA	NA	23 (92)	5 (100)	48 (80)
General and regional anesthesia	NA	NA	8 (32)	5 (100)	13 (22)
Airway/Breathing					
Oxygen	5 (24)	2 (22)	20 (80)	5 (100)	32 (53)

CPAP/BPAP machine	NA	NA	0 (0)	1 (20)	1 (2)
Ambubag	8 (38)	1 (11)	20 (80)	5 (100)	34 (57)
Intubation supplies	2 (10)	4 (44)	12 (48)	5 (100)	23 (38)

Emergency and urgent care capacity in a resource-limited setting: an assessment of health facilities in western Kenya

Authors and affiliations

Thomas F. Burke, MD [a, b, c]

Rosemary Hines [a]

Roy Ahn, MPH, ScD [a, b, c]

Michelle Walters [a]

David Young, MD [a]

Rachel Eleanor Anderson, MD [a]

Sabrina Tom, MD [a]

Rachel Clark [a]

Walter Obita, MD [c]

Brett D. Nelson, MD, MPH [a, b, c]

a. Division of Global Health and Human Rights, Department of Emergency Medicine, Massachusetts General Hospital, Zero Emerson Place, Suite 104, Boston, MA 02114, USA

b. Harvard Medical School, 25 Shattuck St, Boston, MA 02115, USA

c. Sagam Community Hospital, Siaya Road, Luanda 50307, Kenya

Corresponding author:

Thomas F. Burke, MD, FACEP, FRSM

Division of Global Health and Human Rights, Massachusetts General Hospital

Zero Emerson Place, Suite 104, Boston, MA 02114, USA

E-mail tfburke@partners.org

Phone +1-617-584-0064

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. This study was funded internally and by in-kind donation by the authors' Division of Global Health and Human Rights at Massachusetts General Hospital.

Competing interests:

All of the authors have been formally queried, and no authors have competing interests with this study.

Data sharing statement: Extra data are available by emailing tfburke@partners.org.

Author contributions:

TFB was involved in study design, implementation, analysis, and writing of the manuscript. RA was involved in study analysis and writing of the manuscript. RA was involved in study design, implementation, analysis, and writing of the manuscript. MW, DY, REA, ST, RC, and WO were involved in study design and data collection. BDN was involved in study design,

implementation, analysis, and writing of the manuscript. All authors have reviewed, edited, and approved the final submission. TFB takes responsibility for the paper as a whole.

Word count:

2,953~~19~~ words

Keywords:

Emergency medicine

Urgent care

Capacity assessment

Kenya

Pre-hospital care

Abstract

Objective: Injuries, trauma, and non-communicable diseases are responsible for a rising proportion of death and disability in low- and middle-income countries. Delivering effective emergency and urgent health care for these and other conditions in resource-limited settings is challenging. In this study, we sought to ~~understand~~examine and characterize emergency and urgent care capacity in a resource-limited setting.

Methods: We conducted an assessment in western Kenya within all 30 primary and secondary hospitals and within a stratified random sampling of 30 dispensaries and health centers. Key informants were the most senior facility health care provider and manager available. Emergency physician researchers utilized a semi-structured assessment tool, and data were analyzed using descriptive statistics and thematic coding.

Results: No lower-level facilities and 30% of higher-level facilities reported having a defined, organized approach to trauma. Forty-three percent of higher-level facilities have access to an anesthetist. The majority of lower-level facilities have suture and wound care supplies and gloves but typically lack other basic trauma supplies. For cardiac care, 50% of higher-level facilities have morphine, but a minority have functioning ECG, sublingual nitroglycerin, or defibrillator. Only 20% of lower-level facilities have glucometers, and only 33% of higher-level facilities can care for diabetic emergencies. No facilities have sepsis clinical guidelines.

Conclusions: Large gaps in essential emergency care capabilities were identified at all facility levels in western Kenya. There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.

Strengths and limitations of this study:

- This assessment was completed within all 30 primary and secondary hospitals and a stratified random sampling of 30 dispensaries and health centers in western Kenya
- Semi-structured interviews were conducted among facility leadership to ~~understand~~ examine and characterize emergency and urgent care capacity in this resource-limited setting
- Large gaps at all facility levels were identified in essential care capabilities
- There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.
- The study may not be generalizable outside of this region.

Introduction

Background and importance

Providing effective emergency and urgent care is a considerable challenge in low- and middle-income countries. Difficulties exist with regard to transportation, communications, equipment, facility infrastructure, medication supply lines, affordability, and availability of skilled health care providers. Historically, infections caused by communicable diseases have been the major contributors to morbidity and mortality in resource-limited settings. However, traumatic injuries and non-communicable diseases (NCDs), such as heart disease and cancer, are rising rapidly and have recently become recognized as significant contributors to the burden of disease in developing countries. Eighty percent of all NCD deaths in 2008 (29 million) occurred in low- and middle-income countries, with cardiovascular disease, cancers, and respiratory disease the leading causes.[1] Furthermore, 16,000 people die globally each day from injuries alone, accounting for over 15% of the global burden of disease. Approximately 90% of these injuries occur in low- and middle-income countries.[2–4]

Kenya is facing an epidemic of NCDs and an increasing burden of injury and trauma. Between 2003 and 2008, the proportion of deaths related to trauma in western Kenya increased from 2.5% to 5·9%, with road traffic accidents (RTA) the leading cause.[5] In the past, most Kenya public health programs focused on communicable diseases. As a consequence, Kenya has developed disease-specific clinical guidelines for HIV/AIDS, malaria, tuberculosis, and other communicable diseases, but there are currently no national guidelines for emergency care.[6,7] As rates of NCDs and trauma-related injuries and deaths increase, there is a growing urgency to

provide adequate and organized treatment for time-sensitive illnesses and injuries, such as acute myocardial infarction, stroke, trauma, and sepsis.

Recent assessments performed in a select group of facilities in Nigeria, South Africa, and Tanzania documented emergency and critical care services in terms of resources, routines, and guidelines, while a small-scale evaluation of public emergency departments in Kenya described the most common diagnoses of presenting patients.[8–11] Other facility-level studies in Kenya have assessed inpatient care.[12,13] However, nNo assessment of the emergency care capabilities across a region in Kenya has ever been published.

Goals of this investigation

The Division of Global Health and Human Rights in the Department of Emergency Medicine at the Massachusetts General Hospital was approached by the Kenyan Ministry of Health and asked to assess the emergency and urgent health care capabilities across all levels of facilities in Kisumu and Siaya counties of western Kenya. This paper reports major findings from this assessment.

Health care provision in Kenya

Kenya has 6,626 health facilities across 47 counties, serving a population of over 43 million people. Kisumu and Siaya counties have populations of 968,909 (52% urban) and 842,304 (11% urban), respectively.[142,153] There are a total of 150 health facilities in Kisumu (92 public, 15 non-governmental, 15 faith-based, and 28 private) and a total of 162 health facilities in Siaya (115

public, 7 non-governmental, 17 faith-based, and 23 private). The Kenya Essential Package for Health (KEPH) defines the levels of care in Kenya: Level 1 for community-administered care and Levels 2-6 for health care facilities (Table 1).[16 4] Levels 2, 3, 4, 5, and 6 represent dispensaries and clinics, health centers, primary hospitals, secondary hospitals, and tertiary hospitals, respectively.

Methods

Study design and setting

This facility-based emergency care capabilities assessment was conducted between November 1, 2013 and January 20, 2014, in Kisumu and Siaya counties in western Kenya. All 30 Level 4 and 5 facilities in the two counties (there are no Level 6 facilities in these counties) were selected for assessment. Selection of 30 additional facilities occurred via randomized stratified sampling of each additional type of facility – dispensary, health center, and health clinic. The criterion for inclusion was an open ~~fully functioning~~ healthcare facility currently providing health services; there were no restrictions based on geography or accessibility.

Methods and measurements

This facility-based emergency care capabilities assessment utilized semi-structured, key-informant interviews using a data collection instrument designed by the study authors. The key informants were the most senior institution staff members identified during the day of the assessment – typically the chief medical officer and/or senior administrator. The assessment tool drew from existing models of facility assessment in South Africa, Pakistan, and Tanzania, as

well as the WHO Guidelines for Essential Trauma Care.[9,10,175,186] The assessment tool was refined by expert consultation with the team's emergency physicians and public health epidemiologists, and covered eight domains: facility demographics, referral services, personnel, economics, supplies and laboratory, trauma, critical care, and anesthesia. The interviews consisted of open-response questions related to health care services, most common conditions of patients presenting for care, provider capabilities, equipment, supplies, and medications. Qualitative questions pertained to attitudes and perceptions related to provider morale, cooperation and communication between referring and receiving health facilities, and recommendations for continuing education and referral services.

The key-informant interviews were conducted by our field research team – consisting at all times of at least one emergency physician and one research assistant. Three different emergency physicians were involved throughout the data collection process. The delivery of questions and interview structure were discussed *a priori* by all three physician interviewers in order to standardize the interview process. Participants were provided an overview of the project, and the voluntary and confidential nature of the assessment was described. All participants gave verbal consent prior to participation.

Analysis

Data were analyzed using standard descriptive and frequency analyses, utilizing Microsoft Excel 2007 (Seattle, WA, USA). Qualitative research methods involved thematic analysis of interviews in order to best understand emergent findings.

Ethical review and funding

This study was reviewed and approved by the Institutional Review Board of Partners Healthcare (Boston, MA, USA) and the Ministry of Health of Kenya. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Results

A key informant at each of the 60 facilities was surveyed between November 1, 2013 and January 20, 2014. The facility sites were a mix of dispensaries/health clinics, health centers, primary hospitals, and secondary hospitals, as shown in Table 2. (There are no tertiary hospitals in Kisumu or Siaya County.) The 60 key informants comprised 10 chief medical officers (all at the hospital level), 39 nurse managers (facility matron), and 11 lead clinical officers.

Level 2 and 3 Facilities

Common Conditions

Key informants were asked to list the 10 most common emergent and urgent conditions presenting to their health facility. The most frequently reported conditions at Level 2 and 3 facilities were (in rank order) malaria (30/30, 100%), diarrhea (26/30, 87%), upper respiratory infections (24/30, 80%), skin infections (18/30, 60%), sexually transmitted infections (15/30, 50%), pneumonia (14/30, 47%), and RTAs/trauma (9/30, 30%).

Trauma and Injury

When asked if their Level 2 and 3 facilities have a specific approach to a trauma patient that differs from how they approach a medical patient, 0% of key informants answered in the affirmative. In response to how well respondents felt their facility can handle major trauma, all 30 said they refer. Twenty-six (87%) of the 30 said they refer immediately, and four (13%) said they try to provide first aid then refer. The majority of providers (21/30, 70%) said their facility is poorly equipped to handle a broken bone.

The majority of Level 2 and 3 facilities have suture and wound care supplies (26/30, 87%) and gloves (27/60, 90%) (Table 3). Few of these facilities have oxygen (7/30, 23%) and splinting/casting supplies (3/30, 10%), and none have blood for transfusion (0/30, 0%).

Critical Care

When asked about the standard procedure for treating someone with a possible heart attack, all 30 providers at Level 2 and 3 facilities reported that their facility refers. Eighteen (60%) of the 30 reported referring patients immediately, eight (27%) said they treat symptoms (e.g., painkillers, oxygen) and then refer, and four (13%) said they check vitals and then refer. Of the 30 Level 2 and 3 facilities, one has sublingual nitroglycerin.

The majority of providers (29/30, 93%) at the lower-level facilities said that their facility is ill-prepared to handle possible diabetic ketoacidosis (DKA) and must refer all cases. Overall, six (20%) Level 2 and 3 facilities have a glucometer and five (17%) have insulin.

In regards to a standard procedure for cases of possible sepsis, fifteen (50%) of the 30 providers at Level 2 and 3 facilities said they refer, 11 (37%) reported providing treatment without referral (e.g., antibiotics, IV fluids), and four (13%) providers said that they did not know how to approach sepsis. A majority of the Level 2 and 3 facilities (24/30, 80%) have antibiotics.

Facility Levels 4 and 5

Common Conditions

The most frequently reported presenting emergent and urgent conditions at Level 4 and 5 facilities were similar to those at Level 2 and 3 facilities. They are (in rank order): malaria (30/30, 100%), diarrhea (22/30, 73%), sexually transmitted infections (21/30, 70%), pneumonia (21/30, 70%), RTAs/trauma (18/30, 60%), and upper respiratory infections (16/30, 53%).

Trauma and Injury

Nine (30%) providers at Level 4 and 5 facilities reported that their facility has an organized approach to trauma (e.g., emergency team with assembly point). When asked if they are notified in advance of patients arriving to the hospital, four (13%) answered in the affirmative.

In review of basic trauma supplies in Level 4 and 5 facilities, 97% have gloves, 93% have suture and wound care materials, and 83% have oxygen. All five of the Level 5 facilities have chest tubes and x-ray capability, and four of the five have splinting and casting supplies. Three (12%) of the 25 Level 4 facilities have chest tubes and 12 (48%) have x-ray capability. Sixteen (64%) of the 25 Level 4 facilities, and all five of the Level 5 facilities have blood available for transfusion.

Seventeen (57%) providers at Level 4 and 5 facilities reported that their facility does not have access to a trained provider that can administer general or regional anesthesia.

Critical Care

When asked about diagnosis and treatment of someone presenting with a possible acute myocardial infarction (AMI), 20 (80%) of 25 providers at level 4 hospitals reported that their facility refers; 11 (44%) reported that their facility stabilizes (e.g., oxygen or first aid) and then refers, and nine (30%) providers reported that their facility refers immediately. Five (20%) providers at Level 4 facilities reported that their facility provides diagnostic and treatment services without referral (e.g., ACE inhibitors, beta blockers, or aspirin). All 5 Level 5 facilities reported giving oxygen to suspected AMI patients, while three reported providing aspirin, two reported providing morphine and one reported providing epinephrine. Several of the Level 4 and 5 facilities were lacking in supplies and equipment to manage cardiac emergencies. Fifteen (50%) facilities have morphine, six (20%) have a functioning ECG machine, six (20%) have nitroglycerin, and four (13%) have a defibrillator.

Ten (33%) of 30 providers at Level 4 and 5 facilities reported that their facility is well-prepared to manage DKA. A majority of Level 4 and 5 facilities have a glucometer (28/30, 93%) and insulin (24/30, 80%).

When asked about a standard procedure for cases of sepsis, the vast majority (29/30, 97%) of Level 4 and 5 facilities reported providing some treatment for sepsis (e.g., antibiotics, IV fluids),

but none had standardized clinical care guidelines. Twenty-three (92%) of the 25 Level 4 and all five of the Level 5 facilities have vasopressor agents. Twenty-two (88%) of the 25 Level 4 and all five of the Level 5 facilities have antibiotics.

Discussion

With an increasing number of NCDs, RTAs, and other time-sensitive illnesses and injuries, the provision of emergency care in low-and middle-income countries is taking on increasing importance. Our study illustrates that essential emergency and urgent care is severely lacking in western Kenya. Limited communication, infrastructure, supplies, and properly trained human resources all negatively impact the ability to deliver quality emergency and urgent health care.

Although by definition Level 2 and Level 3 facilities in Kenya are not designed nor expected to provide comprehensive care for acutely ill patients, we elected to study their capabilities around emergency care since community members often present to them with acute life-threatening illnesses and injuries. We discovered that virtually all of the 30 Level 2 and 3 facilities we studied were unable to respond to the essential needs of patients presenting with acute trauma, a possible heart attack, diabetic emergencies, or sepsis. Most facilities reported transferring patients without even basic assessments or interventions. Few facilities had any organized approach in transferring a patient or notifying the receiving facility.

The authors view the Level 2 and 3 facility findings as a compelling call to action for the development of a contextually appropriate, standardized basic level training and materials

package for emergency care. For example, a training program in the essentials of emergency care for Level 2 and 3 facilities should include the development of a standard approach to all acute care patients: basic assessment and intervention of airway, breathing, and circulation; taking and interpreting vital signs; methodical total body assessment; hemorrhage control; immobilization and splinting of potential injuries; capabilities of providing basic high-impact diagnostics and interventions (e.g., point-of-care glucose, ECG, aspirin, antibiotics, splints); and a pre-established reliable and rapid referral and notification plan.

While emergent and urgent conditions present frequently to Level 4 and 5 facilities, we discovered that the hospitals' capabilities varied considerably. While all of the 30 facilities had gaps across each of the domains we studied, many of the gaps at the Level 4 facilities were quite profound. Overall, some of the more salient findings in the Level 4 and 5 facilities' assessments were: 70% do not have a standardized approach to trauma, few have the basic materials necessary to manage trauma (e.g. chest tube, blood), less than half have a functioning x-ray machine, less than half (43%) of the operating theatres have access to an anesthetist, only six of 30 have EKG machines or nitroglycerin, most do not give aspirin for heart attacks, few are able to provide care for DKA, and no facility had a standardized approach to sepsis.

The findings from our Level 4 and Level 5 facility assessment demonstrate an urgent need for a system-wide intervention, targeting the unmet higher-level facility needs of the acutely ill and injured. Many of the Level 4 and 5 facilities do not meet the most basic standard for the essentials of emergency care delivery that we believe can – and should – be universally

implemented at all lower-level facilities. We propose that in addition to every facility being brought up to the basic level, a second package in essentials of advanced emergency care should be developed and deployed to select Level 4 and 5 facilities. These selected facilities, once meeting standards for training, materials, and infrastructure, should then be designated and widely recognized and supported as *centers of excellence for advanced emergency care*, and thereby capable of providing quality assessment and initial stabilization of all emergent and urgent conditions.

Access to quality pre-hospital care services was universally poor in our study sample and can be seen as an opportunity for organization and improvement. A basic pre-hospital system should be created by establishing a mechanism to access reliable transportation staffed with personnel who have basic life-support skills. Elsewhere, it has been shown that training lay people in the community, such as community health workers or public transportation drivers to function as pre-hospital care providers, can greatly improve the quality of emergency care.[19~~7~~] Additionally, a standardized communication method ought to be instituted. For example, in Sierra Leone, it has been shown that equipping remote health facilities and traditional birth attendants with radio receivers linked to referral hospitals can shorten response times and reduce maternal deaths.[20~~18~~]

Although not addressed in this study, it is likely that these findings would be similar elsewhere across sub-Saharan Africa. If this assessment is indeed generalizable, the authors believe that the development of a set of standardized packages for basic and advanced essentials of

emergency care in low-resource settings, as well as designating *centers of excellence for advanced emergency care,* should be a priority for the WHO and other stakeholders. The African Federation for Emergency Medicine has been developing consensus recommendations for emergency care packages for various facility levels.[21]

Our study had several limitations. Although we believe the lessons learned are representative of counties in Kenya and other low-resource settings globally, our findings are not definitively generalizable beyond the two counties surveyed. Furthermore, we recognize that elements of our survey may have been limited by social desirability bias. Although we tried to mitigate this with the ~~anonymous~~ confidential and voluntary nature of our survey and by explaining the purpose of our study, participants may not have felt comfortable reporting problems or inadequacies in their facilities. While our research staff included a local Kenyan who was present at all site visits and functioned as a language and cultural ambassador, language and cultural differences may have contributed to confounding variables. Furthermore, while informants were selected based on their senior leadership roles and expertise with the operations of their facility, their responses might not have always accurately reflected opinions of the majority of providers at the facility.

In conclusion, with an increasing epidemic of NCDs and an increasing burden of injury and trauma in low-resource areas, access to quality essential emergency and urgent care services is critical for the health of surrounding communities. Our 60-facility assessment in western Kenya identified significant widespread gaps in current emergency care capabilities, particularly in

identifying and appropriately caring for victims of trauma, acute myocardial infarction, diabetic emergencies, and sepsis. There is great opportunity for development of a universally deployed basic package in the essentials of emergency care, a selectively implemented package in the essentials of advanced emergency care, a center of excellence for emergency care facility designation scheme, and a reliable pre-hospital care transportation and communications system. Additionally, the profound gap in readily available trained anesthetists requires immediate attention.

Table 1: Description of levels of care in Kenya

Level 1	Community	- Care outside facility in households, communities, and villages - Maximum population served: 5,000
Level 2	Dispensaries/ Clinics	- Has limited staff (nurses, public health technicians, and assistants) - Responsible for community engagement through curative, promotive, preventive, and rehabilitative care at a basic level - Up to four beds for observation - Maximum population served: 10,000(rural) - 15,000(urban)
Level 3	Health Centers	- Staffed by nurses, clinical officers, and occasionally doctors - Wider range of curative and preventive services than Level 2 - Provide minor surgical services, like incision and drainage - Basic emergency preparedness - 12-49 beds - Maximum population served: 30,000-40,000
Level 4	Primary Hospitals	- Provide referral level outpatient care, curative and preventive care, surgical treatment techniques, and comprehensive emergency services - Provide clinical services in obstetrics and gynecology, child health, medicine, and surgery and anesthesia - Inpatient care and 24-hour service - Minimum 50 beds - Maximum population served: 100,000(rural) - 200,000(urban)

Level 5-6	Secondary/ Tertiary Hospitals	- Higher concentration of resources and personnel (medical professionals, nurses, and midwives) - Provide clinical services in medicine, general surgery and anesthesia, pediatrics, and obstetrics/gynecology, dental, psychiatry, comprehensive accident and emergency, ENT, ophthalmology, dermatology, ICU - Minimum 50 beds - Maximum population served: 1,000,000

Table 2: Health facilities studied in Kisumu and Siaya counties in Kenya; November 2013-January 2014

Type of Health Facility	Kisumu	Siaya	Total
Dispensary/Health Clinic (Level 2)	9	12	**21**
Health Center (Level 3)	6	3	**9**
Primary Hospitals (Level 4)	18	6	**25**
Secondary Hospitals (Level 5)	4	1	**5**
Total	**38**	**22**	**60**

Table 3: Functioning supplies and equipment at health facilities in Kisumu and Siaya, Kenya (number of facilities)

	Level 2 n=21 (%)	Level 3 n=9 (%)	Level 4 n=25 (%)	Level 5 n=5 (%)	Total n=60 (%)
General					
Gloves	20 (95)	7 (78)	24 (96)	5 (100)	56 (93)
Face masks	10 (48)	4 (44)	21 (84)	5 (100)	40 (67)
Gowns	3 (14)	4 (44)	17 (68)	5 (100)	29 (48)
Monitored beds	NA	NA	1 (4)	4 (80)	6 (10)
Central line kits	NA	NA	1 (4)	4 (80)	5 (8)
Suction	5 (24)	4 (44)	19 (76)	4 (80)	32 (53)
Blood pressure cuffs	18 (86)	6 (67)	23 (92)	5 (100)	52 (87)
Splint/cast supplies	2 (10)	1 (11)	14 (56)	4 (80)	21 (35)
Suture and wound-care supplies	18 (86)	8 (89)	23 (92)	5 (100)	54 (90)
Defibrillator	1 (5)	0 (0)	1 (4)	3 (60)	5 (8)
Back-up power	1 (5)	2 (22)	14 (56)	5 (100)	22 (42)
Chest tube trays	1 (5)	1 (11)	3 (12)	5 (100)	10 (17)

Laboratory/Diagnostics					
Ultrasound	1 (5)	0 (0)	9 (36)	5 (100)	15 (25)
ECG	0 (0)	1 (11)	3 (12)	3 (60)	8 (13)
X-ray	1 (5)	0 (0)	12 (48)	5 (100)	18 (30)
Otoscope	5 (24)	4 (44)	14 (56)	5 (100)	28 (47)
Ophthalmoscope	4 (19)	4 (44)	13 (52)	5 (100)	26 (43)
Glucometer	3 (14)	3 (33)	23 (92)	5 (100)	34 (57)
Medications					
Nitroglycerin	0 (0)	1 (11)	4 (16)	2 (40)	7 (12)
Antibiotics	16 (76)	8 (89)	22 (88)	5 (100)	51 (85)
Opiates	0 (0)	0 (0)	10 (40)	5 (100)	15 (25)
Insulin	4 (19)	1 (11)	19 (76)	5 (100)	29 (48)
Pressors	NA	NA	23 (92)	5 (100)	48 (80)
General and regional anesthesia	NA	NA	8 (32)	5 (100)	13 (22)
Airway/Breathing					
Oxygen	5 (24)	2 (22)	20 (80)	5 (100)	32 (53)

CPAP/BPAP machine	NA	NA	0 (0)	1 (20)	1 (2)
Ambubag	8 (38)	1 (11)	20 (80)	5 (100)	34 (57)
Intubation supplies	2 (10)	4 (44)	12 (48)	5 (100)	23 (38)

References

1 World Health Organization. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization, 2010.

2 Peden M, McGee K, Sharma G. The injury chartbook: A graphical overview of the global burden of injuries. Geneva: World Health Organization, 2002.

3 Gosselin R, Spiegel D, Coughlin R, et al. Injuries: the neglected burden in developing countries. *Bulletin of the World Health Organization* 2009; **87**:246.

4 Mock C, Lormand JD, Goosen J, et al. Guidelines for essential trauma care. Geneva: World Health Organization, 2004.

5 Odhiambo FO, Beynon CM, Ogwang S, et al. Trauma-related mortality among adults in rural western Kenya: Characterising deaths using data from a health and demographic surveillance system. *PLoS ONE* 2013; **8**(11):e79840.

6 Ministry of Health, Government of Kenya. Guidelines for antiretroviral drug therapy in Kenya. 2011. Available at: http://www.who.int/hiv/pub/guidelines/kenya_art.pdf. Accessed 7 May 2014.

7 Ministry of Public Health and Sanitation. Guidelines on management of leprosy and tuberculosis. 2009. Available at: http://www.who.int/hiv/pub/guidelines/kenya_tb.pdf. Accessed 7 May 2014.

8 Baker T, Lugazia E, Eriksen J, et al. Emergency and critical care services in Tanzania: A survey of ten hospitals. *BMC Health Services Research* 2013; **13**:140.

9 Wallis LA, Garach SR, Kropman A. State of emergency medicine in South Africa. *Int J Emerg Med* 2008; **1**(2):69–71.

10 Wen LS, Oshiomogho JI, Eluwa GI, et al. Characteristics and capabilities of emergency departments in Abuja, Nigeria. *Emerg Med J* 2012; **29**(10):798–801.

11 Wachira BW, Wallis LA, Geduld H. An analysis of the clinical practice of emergency medicine in public emergency departments in Kenya. *Emerg Med J* 2012; **29**(6):473–6.

12 Mwaniki P, Ayieko P, Todd J, et al. Assessment of paediatric inpatient care during a multifaceted quality improvement intervention in Kenyan district hospitals: Use of prospectively collected case record data. *BMC Health Serv Res* 2014; **14**:312.

13 Irimu GW, Gathara D, Zurovac D, et al. Performance of health workers in the management of seriously sick children at a Kenyan tertiary hospital: Before and after a training intervention. *PLoS One* 2012; **7**(7):e39964.

142 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

153 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

164 Luoma M, Doherty J, Muchiri S, et al. August 2010. *Kenya Health System Assessment* 2010. Bethesda, MD: Health Systems 20/20 project, Abt Associates Inc.

175 World Health Organization. Guidelines for essential trauma care. Geneva, World Health Organization, 2004.

186 Razzak JA, Hyder AA, Akhtar T, et al. Assessing emergency medical care in low-income countries: A pilot study from Pakistan. *BMC Emergency Medicine* 2008; **8**:8.

197 Mock CN, Tiska M, Adu-Ampofo M, et al. Improvements in prehospital trauma care in an African country with no formal emergency medical services. *J Trauma* 2002; **53**(1): 90–7.

2018 Samai O, Senegeh P. Facilitating emergency obstetrical care through transportation and communication, Bo, Sierra Leone. *International Journal of Gynecology and Obstetrics* 1997; 59 Suppl **2**:S157–64.

21 Calvello E, Reynolds T, Hirshon JM, Buckle C, Moresky R, O'Neill J, Wallis LA. Emergency care in sub-Saharan Africa: Results of a consensus conference. *African Journal of Emergency Medicine* 2013; **3**(1): 42–8.

Manuscript: Emergency and urgent care capacity: an assessment of health facilities in western Kenya

Thomas F. Burke, et al.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	DONE	PAGE
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	X	1, 5
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	X	5
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	X	6-8
Objectives	3	State specific objectives, including any prespecified hypotheses	X	8
Methods				
Study design	4	Present key elements of study design early in the paper	X	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	X	8-10
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	X	9-10
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	X	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	X	9
Bias	9	Describe any efforts to address potential sources of bias	X	17-18
Study size	10	Explain how the study size was arrived at	N/A	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	N/A	N/A
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	X	9-10
		(*b*) Describe any methods used to examine subgroups and	N/A	N/A

		interactions		
		(*c*) Explain how missing data were addressed	N/A	N/A
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	N/A	N/A
		(*e*) Describe any sensitivity analyses	N/A	N/A
Results			**DONE**	**PAGE**
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	X	10
		(b) Give reasons for non-participation at each stage	N/A	N/A
		(c) Consider use of a flow diagram	N/A	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	X	10, 22
		(b) Indicate number of participants with missing data for each variable of interest	N/A	N/A
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)	N/A	N/A
Outcome data	15*	Cohort study—Report numbers of outcome events or summary measures over time	N/A	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	X	23-25
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A	N/A
		(b) Report category boundaries when continuous variables were categorized	N/A	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	X	9
Discussion				
Key results	18	Summarise key results with reference to study objectives	X	14-15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	X	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	X	15-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	X	17
Other information				

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	X	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Emergency and urgent care capacity in a resource-limited setting: an assessment of health facilities in western Kenya

Journal:	*BMJ Open*
Manuscript ID:	bmjopen-2014-006132.R2
Article Type:	Research
Date Submitted by the Author:	08-Sep-2014
Complete List of Authors:	Burke, Thomas; Massachusetts General Hospital, Department of Emergency Medicine Hines, Rosemary; Massachusetts General Hospital, Department of Emergency Medicine Ahn, Roy; Massachusetts General Hospital, Department of Emergency Medicine Walters, Michelle; Massachusetts General Hospital, Department of Emergency Medicine Young, David; Massachusetts General Hospital, Department of Emergency Medicine Anderson, Rachel; Massachusetts General Hospital, Department of Emergency Medicine Tom, Sabrina; Massachusetts General Hospital, Department of Emergency Medicine Clark, Rachel; Massachusetts General Hospital, Department of Emergency Medicine Obita, Walter; Sagam Community Hospital, Nelson, Brett; Massachusetts General Hospital, Department of Emergency Medicine
Primary Subject Heading:	Emergency medicine
Secondary Subject Heading:	Global health
Keywords:	ACCIDENT & EMERGENCY MEDICINE, International health services < HEALTH SERVICES ADMINISTRATION & MANAGEMENT, TRAUMA MANAGEMENT

Manuscript: Emergency and urgent care capacity: an assessment of health facilities in western Kenya

Thomas F. Burke, et al.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	DONE	PAGE
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	X	1, 5
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	X	5
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	X	6-8
Objectives	3	State specific objectives, including any prespecified hypotheses	X	8
Methods				
Study design	4	Present key elements of study design early in the paper	X	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	X	8-10
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	X	9-10
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	X	9
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	X	9
Bias	9	Describe any efforts to address potential sources of bias	X	17-18
Study size	10	Explain how the study size was arrived at	N/A	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	N/A	N/A
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	X	9-10
		(*b*) Describe any methods used to examine subgroups and	N/A	N/A

		interactions		
		(*c*) Explain how missing data were addressed	N/A	N/A
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	N/A	N/A
		(*e*) Describe any sensitivity analyses	N/A	N/A
Results			**DONE**	**PAGE**
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	X	10
		(b) Give reasons for non-participation at each stage	N/A	N/A
		(c) Consider use of a flow diagram	N/A	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	X	10, 22
		(b) Indicate number of participants with missing data for each variable of interest	N/A	N/A
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)	N/A	N/A
Outcome data	15*	Cohort study—Report numbers of outcome events or summary measures over time	N/A	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	X	23-25
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A	N/A
		(b) Report category boundaries when continuous variables were categorized	N/A	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	X	9
Discussion				
Key results	18	Summarise key results with reference to study objectives	X	14-15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	X	17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	X	15-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	X	17
Other information				

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	X	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

Emergency and urgent care capacity in a resource-limited setting: an assessment of health facilities in western Kenya

Authors and affiliations

Thomas F. Burke, MD [a, b, c]

Rosemary Hines [a]

Roy Ahn, MPH, ScD [a, b, c]

Michelle Walters [a]

David Young, MD [a]

Rachel Eleanor Anderson, MD [a]

Sabrina Tom, MD [a]

Rachel Clark [a]

Walter Obita, MD [c]

Brett D. Nelson, MD, MPH [a, b, c]

a. Division of Global Health and Human Rights, Department of Emergency Medicine, Massachusetts General Hospital, Zero Emerson Place, Suite 104, Boston, MA 02114, USA

b. Harvard Medical School, 25 Shattuck St, Boston, MA 02115, USA

c. Sagam Community Hospital, Siaya Road, Luanda 50307, Kenya

Corresponding author:

Thomas F. Burke, MD, FACEP, FRSM

Division of Global Health and Human Rights, Massachusetts General Hospital

Zero Emerson Place, Suite 104, Boston, MA 02114, USA

E-mail tfburke@partners.org

Phone +1-617-584-0064

Word count:

2,963 words

Keywords:

Emergency medicine

Urgent care

Capacity assessment

Kenya

Pre-hospital care

Abstract

Objective: Injuries, trauma, and non-communicable diseases are responsible for a rising proportion of death and disability in low- and middle-income countries. Delivering effective emergency and urgent health care for these and other conditions in resource-limited settings is challenging. In this study, we sought to examine and characterize emergency and urgent care capacity in a resource-limited setting.

Methods: We conducted an assessment in western Kenya within all 30 primary and secondary hospitals and within a stratified random sampling of 30 dispensaries and health centers. Key informants were the most senior facility health care provider and manager available. Emergency physician researchers utilized a semi-structured assessment tool, and data were analyzed using descriptive statistics and thematic coding.

Results: No lower-level facilities and 30% of higher-level facilities reported having a defined, organized approach to trauma. Forty-three percent of higher-level facilities had access to an anesthetist. The majority of lower-level facilities had suture and wound care supplies and gloves but typically lacked other basic trauma supplies. For cardiac care, 50% of higher-level facilities had morphine, but a minority had functioning ECG, sublingual nitroglycerin, or defibrillator. Only 20% of lower-level facilities had glucometers, and only 33% of higher-level facilities could care for diabetic emergencies. No facilities had sepsis clinical guidelines.

Conclusions: Large gaps in essential emergency care capabilities were identified at all facility levels in western Kenya. There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.

Strengths and limitations of this study:

- This assessment was completed within all 30 primary and secondary hospitals and a stratified random sampling of 30 dispensaries and health centers in western Kenya
- Semi-structured interviews were conducted among facility leadership to examine and characterize emergency and urgent care capacity in this resource-limited setting
- Large gaps at all facility levels were identified in essential care capabilities
- There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.
- The study may not be generalizable outside of this region.

Introduction

Background and importance

Providing effective emergency and urgent care is a considerable challenge in low- and middle-income countries. Difficulties exist with regard to transportation, communications, equipment, facility infrastructure, medication supply lines, affordability, and availability of skilled health care providers. Historically, infections caused by communicable diseases have been the major contributors to morbidity and mortality in resource-limited settings. However, traumatic injuries and non-communicable diseases (NCDs), such as heart disease and cancer, are rising rapidly and have recently become recognized as significant contributors to the burden of disease in developing countries. Eighty percent of all NCD deaths in 2008 (29 million) occurred in low- and middle-income countries, with cardiovascular disease, cancers, and respiratory disease the leading causes.[1] Furthermore, 16,000 people die globally each day from injuries alone, accounting for over 15% of the global burden of disease. Approximately 90% of these injuries occur in low- and middle-income countries.[2–4]

Kenya is facing an epidemic of NCDs and an increasing burden of injury and trauma. Between 2003 and 2008, the proportion of deaths related to trauma in western Kenya increased from 2.5% to 5·9%, with road traffic accidents (RTA) the leading cause.[5] In the past, most Kenya public health programs focused on communicable diseases. As a consequence, Kenya has developed disease-specific clinical guidelines for HIV/AIDS, malaria, tuberculosis, and other communicable diseases, but there are currently no national guidelines for emergency care.[6,7] As rates of NCDs and trauma-related injuries and deaths increase, there is a growing urgency to

provide adequate and organized treatment for time-sensitive illnesses and injuries, such as acute myocardial infarction, stroke, trauma, and sepsis.

Recent assessments performed in a select group of facilities in Nigeria, South Africa, and Tanzania documented emergency and critical care services in terms of resources, routines, and guidelines, while a small-scale evaluation of public emergency departments in Kenya described the most common diagnoses of presenting patients.[8–11] Other facility-level studies in Kenya have assessed inpatient care.[12,13] However, no assessment of the emergency care capabilities across a region in Kenya has ever been published.

Goals of this investigation

The Division of Global Health and Human Rights in the Department of Emergency Medicine at the Massachusetts General Hospital was approached by the Kenyan Ministry of Health and asked to assess the emergency and urgent health care capabilities across all levels of facilities in Kisumu and Siaya counties of western Kenya. This paper reports major findings from this assessment.

Health care provision in Kenya

Kenya has 6,626 health facilities across 47 counties, serving a population of over 43 million people. Kisumu and Siaya counties have populations of 968,909 (52% urban) and 842,304 (11% urban), respectively.[14,15] There are a total of 150 health facilities in Kisumu (92 public, 15 non-governmental, 15 faith-based, and 28 private) and a total of 162 health facilities in Siaya (115

public, 7 non-governmental, 17 faith-based, and 23 private). The Kenya Essential Package for Health (KEPH) defines the levels of care in Kenya: Level 1 for community-administered care and Levels 2-6 for health care facilities (Table 1).[16] Levels 2, 3, 4, 5, and 6 represent dispensaries and clinics, health centers, primary hospitals, secondary hospitals, and tertiary hospitals, respectively.

Methods

Study design and setting

This facility-based emergency care capabilities assessment was conducted between November 1, 2013 and January 20, 2014, in Kisumu and Siaya counties in western Kenya. All 30 Level 4 and 5 facilities in the two counties (there are no Level 6 facilities in these counties) were selected for assessment. Selection of 30 additional facilities occurred via randomized stratified sampling of each additional type of facility – dispensary, health center, and health clinic. The criterion for inclusion was an open healthcare facility currently providing health services; there were no restrictions based on geography or accessibility.

Methods and measurements

This facility-based emergency care capabilities assessment utilized semi-structured, key-informant interviews using a data collection instrument designed by the study authors. The key informants were the most senior institution staff members identified during the day of the assessment – typically the chief medical officer and/or senior administrator. The assessment tool drew from existing models of facility assessment in South Africa, Pakistan, and Tanzania, as

well as the WHO Guidelines for Essential Trauma Care.[9,10,17,18] The assessment tool was refined by expert consultation with the team's emergency physicians and public health epidemiologists, and covered eight domains: facility demographics, referral services, personnel, economics, supplies and laboratory, trauma, critical care, and anesthesia. The interviews consisted of open-response questions related to health care services, most common conditions of patients presenting for care, provider capabilities, equipment, supplies, and medications. Qualitative questions pertained to attitudes and perceptions related to provider morale, cooperation and communication between referring and receiving health facilities, and recommendations for continuing education and referral services.

The key-informant interviews were conducted by our field research team – consisting at all times of at least one emergency physician and one research assistant. Three different emergency physicians were involved throughout the data collection process. The delivery of questions and interview structure were discussed *a priori* by all three physician interviewers in order to standardize the interview process. Participants were provided an overview of the project, and the voluntary and confidential nature of the assessment was described. All participants gave verbal consent prior to participation.

Analysis

Data were analyzed using standard descriptive and frequency analyses, utilizing Microsoft Excel 2007 (Seattle, WA, USA). Qualitative research methods involved thematic analysis of interviews in order to best understand emergent findings.

Ethical review and funding

This study was reviewed and approved by the Institutional Review Board of Partners Healthcare (Boston, MA, USA) and the Ministry of Health of Kenya. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Results

A key informant at each of the 60 facilities was surveyed between November 1, 2013 and January 20, 2014. The facility sites were a mix of dispensaries/health clinics, health centers, primary hospitals, and secondary hospitals, as shown in Table 2. (There are no tertiary hospitals in Kisumu or Siaya County.) The 60 key informants comprised 10 chief medical officers (all at the hospital level), 39 nurse managers (facility matron), and 11 lead clinical officers.

Level 2 and 3 Facilities

Common Conditions

Key informants were asked by open response to list the 10 most common emergent and urgent conditions presenting to their health facility. The most frequently reported conditions at Level 2 and 3 facilities were (in order of reporting frequency) malaria (30 of 30 facilities, 100%), diarrhea (26/30, 87%), upper respiratory infections (24/30, 80%), skin infections (18/30, 60%), sexually transmitted infections (15/30, 50%), pneumonia (14/30, 47%), and RTAs/trauma (9/30, 30%).

Trauma and Injury

When asked if their Level 2 and 3 facilities have a specific approach to a trauma patient that differs from how they approach a medical patient, 0% of key informants answered in the affirmative. In response to how well respondents felt their facility can handle major trauma, all 30 said they refer. Twenty-six (87%) of the 30 said they refer immediately, and four (13%) said they try to provide first aid then refer. The majority of providers (21/30, 70%) said their facility is poorly equipped to handle a broken bone.

The majority of Level 2 and 3 facilities had suture and wound care supplies (26/30, 87%) and gloves (27/60, 90%) (Table 3). Few of these facilities had oxygen (7/30, 23%) and splinting/casting supplies (3/30, 10%), and none had blood for transfusion (0/30, 0%).

Critical Care

When asked about the standard procedure for treating someone with a possible heart attack, all 30 providers at Level 2 and 3 facilities reported that their facility refers. Eighteen (60%) of the 30 reported referring patients immediately, eight (27%) said they treat symptoms (e.g., painkillers, oxygen) and then refer, and four (13%) said they check vitals and then refer. Of the 30 Level 2 and 3 facilities, one had sublingual nitroglycerin.

The majority of providers (29/30, 93%) at the lower-level facilities said that their facility is ill-prepared to handle possible diabetic ketoacidosis (DKA) and must refer all cases. Overall, six (20%) Level 2 and 3 facilities had a glucometer and five (17%) had insulin.

In regards to a standard procedure for cases of possible sepsis, fifteen (50%) of the 30 providers at Level 2 and 3 facilities said they refer, 11 (37%) reported providing treatment without referral (e.g., antibiotics, IV fluids), and four (13%) providers said that they did not know how to approach sepsis. A majority of the Level 2 and 3 facilities (24/30, 80%) had antibiotics.

Facility Levels 4 and 5

Common Conditions

The most frequently reported presenting emergent and urgent conditions at Level 4 and 5 facilities were similar to those at Level 2 and 3 facilities. They are (in order of reporting frequency) malaria (30/30, 100%), diarrhea (22/30, 73%), sexually transmitted infections (21/30, 70%), pneumonia (21/30, 70%), RTAs/trauma (18/30, 60%), and upper respiratory infections (16/30, 53%).

Trauma and Injury

Nine (30%) providers at Level 4 and 5 facilities reported that their facility has an organized approach to trauma (e.g., emergency team with assembly point). When asked if they are notified in advance of patients arriving to the hospital, four (13%) answered in the affirmative.

In review of basic trauma supplies in Level 4 and 5 facilities, 97% had gloves, 93% had suture and wound care materials, and 83% had oxygen. All five of the Level 5 facilities had chest tubes and x-ray capability, and four of the five had splinting and casting supplies. Three (12%) of the 25 Level 4 facilities had chest tubes and 12 (48%) had x-ray capability. Sixteen (64%) of the 25

Level 4 facilities, and all five of the Level 5 facilities had blood available for transfusion. Seventeen (57%) providers at Level 4 and 5 facilities reported that their facility did not have access to a trained provider that can administer general or regional anesthesia.

Critical Care

When asked about diagnosis and treatment of someone presenting with a possible acute myocardial infarction (AMI), 20 (80%) of 25 providers at level 4 hospitals reported that their facility refers; 11 (44%) reported that their facility stabilizes (e.g., oxygen or first aid) and then refers, and nine (30%) providers reported that their facility refers immediately. Five (20%) providers at Level 4 facilities reported that their facility provides diagnostic and treatment services without referral (e.g., ACE inhibitors, beta blockers, or aspirin). All 5 Level 5 facilities reported giving oxygen to suspected AMI patients, while three reported providing aspirin, two reported providing morphine and one reported providing epinephrine. Several of the Level 4 and 5 facilities were lacking in supplies and equipment to manage cardiac emergencies. Fifteen (50%) facilities had morphine, six (20%) had a functioning ECG machine, six (20%) had nitroglycerin, and four (13%) had a defibrillator.

Ten (33%) of 30 providers at Level 4 and 5 facilities reported that their facility is well-prepared to manage DKA. A majority of Level 4 and 5 facilities had a glucometer (28/30, 93%) and insulin (24/30, 80%).

When asked about a standard procedure for cases of sepsis, the vast majority (29/30, 97%) of Level 4 and 5 facilities reported providing some treatment for sepsis (e.g., antibiotics, IV fluids), but none had standardized clinical care guidelines. Twenty-three (92%) of the 25 Level 4 and all five of the Level 5 facilities had vasopressor agents. Twenty-two (88%) of the 25 Level 4 and all five of the Level 5 facilities had antibiotics.

Discussion

With an increasing number of NCDs, RTAs, and other time-sensitive illnesses and injuries, the provision of emergency care in low-and middle-income countries is taking on increasing importance. Our study illustrates that essential emergency and urgent care is severely lacking in western Kenya. Limited communication, infrastructure, supplies, and properly trained human resources all negatively impact the ability to deliver quality emergency and urgent health care.

Although by definition Level 2 and Level 3 facilities in Kenya are not designed nor expected to provide comprehensive care for acutely ill patients, we elected to study their capabilities around emergency care since community members often present to them with acute life-threatening illnesses and injuries. We discovered that virtually all of the 30 Level 2 and 3 facilities we studied were unable to respond to the essential needs of patients presenting with acute trauma, a possible heart attack, diabetic emergencies, or sepsis. Most facilities reported transferring patients without even basic assessments or interventions. Few facilities had any organized approach in transferring a patient or notifying the receiving facility.

The authors view the Level 2 and 3 facility findings as a compelling call to action for the development of a contextually appropriate, standardized basic level training and materials package for emergency care. For example, a training program in the essentials of emergency care for Level 2 and 3 facilities should include the development of a standard approach to all acute care patients: basic assessment and intervention of airway, breathing, and circulation; taking and interpreting vital signs; methodical total body assessment; hemorrhage control; immobilization and splinting of potential injuries; capabilities of providing basic high-impact diagnostics and interventions (e.g., point-of-care glucose, ECG, aspirin, antibiotics, splints); and a pre-established reliable and rapid referral and notification plan.

While emergent and urgent conditions present frequently to Level 4 and 5 facilities, we discovered that the hospitals' capabilities varied considerably. While all of the 30 facilities had gaps across each of the domains we studied, many of the gaps at the Level 4 facilities were quite profound. Overall, some of the more salient findings in the Level 4 and 5 facilities' assessments were: 70% do not have a standardized approach to trauma, few have the basic materials necessary to manage trauma (e.g. chest tube, blood), less than half have a functioning x-ray machine, less than half (43%) of the operating theatres have access to an anesthetist, only six of 30 have EKG machines or nitroglycerin, most do not give aspirin for heart attacks, few are able to provide care for DKA, and no facility had a standardized approach to sepsis.

The findings from our Level 4 and Level 5 facility assessment demonstrate an urgent need for a system-wide intervention, targeting the unmet higher-level facility needs of the acutely ill and

injured. Many of the Level 4 and 5 facilities did not meet the most basic standard for the essentials of emergency care delivery that we believe can – and should – be universally implemented at all lower-level facilities. We propose that in addition to every facility being brought up to the basic level, a second package in essentials of advanced emergency care should be developed and deployed to select Level 4 and 5 facilities. These selected facilities, once meeting standards for training, materials, and infrastructure, should then be designated and widely recognized and supported as *centers of excellence for advanced emergency care*, and thereby capable of providing quality assessment and initial stabilization of all emergent and urgent conditions.

Access to quality pre-hospital care services was universally poor in our study sample and can be seen as an opportunity for organization and improvement. A basic pre-hospital system should be created by establishing a mechanism to access reliable transportation staffed with personnel who have basic life-support skills. Elsewhere, it has been shown that training lay people in the community, such as community health workers or public transportation drivers to function as pre-hospital care providers, can greatly improve the quality of emergency care.[19] Additionally, a standardized communication method ought to be instituted. For example, in Sierra Leone, it has been shown that equipping remote health facilities and traditional birth attendants with radio receivers linked to referral hospitals can shorten response times and reduce maternal deaths.[20]

Although not addressed in this study, it is likely that these findings would be similar elsewhere across sub-Saharan Africa. If this assessment is indeed generalizable, the authors believe that the development of a set of standardized packages for basic and advanced essentials of emergency care in low-resource settings, as well as designating *centers of excellence for advanced emergency care,* should be a priority for the WHO and other stakeholders. The African Federation for Emergency Medicine has been developing consensus recommendations for emergency care packages for various facility levels.[21]

Our study had several limitations. Although we believe the lessons learned are representative of counties in Kenya and other low-resource settings globally, our findings are not definitively generalizable beyond the two counties surveyed. Furthermore, we recognize that elements of our survey may have been limited by social desirability bias. Although we tried to mitigate this with the confidential and voluntary nature of our survey and by explaining the purpose of our study, participants may not have felt comfortable reporting problems or inadequacies in their facilities. While our research staff included a local Kenyan who was present at all site visits and functioned as a language and cultural ambassador, language and cultural differences may have contributed to confounding variables. Furthermore, while informants were selected based on their senior leadership roles and expertise with the operations of their facility, their responses might not have always accurately reflected opinions of the majority of providers at the facility.

In conclusion, with an increasing epidemic of NCDs and an increasing burden of injury and trauma in low-resource areas, access to quality essential emergency and urgent care services is

critical for the health of surrounding communities. Our 60-facility assessment in western Kenya identified significant widespread gaps in current emergency care capabilities, particularly in identifying and appropriately caring for victims of trauma, acute myocardial infarction, diabetic emergencies, and sepsis. There is great opportunity for development of a universally deployed basic package in the essentials of emergency care, a selectively implemented package in the essentials of advanced emergency care, a center of excellence for emergency care facility designation scheme, and a reliable pre-hospital care transportation and communications system. Additionally, the profound gap in readily available trained anesthetists requires immediate attention.

Table 1: Description of levels of care in Kenya

Level 1	Community	- Care outside facility in households, communities, and villages - Maximum population served: 5,000
Level 2	Dispensaries/ Clinics	- Has limited staff (nurses, public health technicians, and assistants) - Responsible for community engagement through curative, promotive, preventive, and rehabilitative care at a basic level - Up to four beds for observation - Maximum population served: 10,000(rural) - 15,000(urban)
Level 3	Health Centers	- Staffed by nurses, clinical officers, and occasionally doctors - Wider range of curative and preventive services than Level 2 - Provide minor surgical services, like incision and drainage - Basic emergency preparedness - 12-49 beds - Maximum population served: 30,000-40,000
Level 4	Primary Hospitals	- Provide referral level outpatient care, curative and preventive care, surgical treatment techniques, and comprehensive emergency services - Provide clinical services in obstetrics and gynecology, child health, medicine, and surgery and anesthesia - Inpatient care and 24-hour service - Minimum 50 beds - Maximum population served: 100,000(rural) - 200,000(urban)

Level 5-6	Secondary/ Tertiary Hospitals	- Higher concentration of resources and personnel (medical professionals, nurses, and midwives) - Provide clinical services in medicine, general surgery and anesthesia, pediatrics, and obstetrics/gynecology, dental, psychiatry, comprehensive accident and emergency, ENT, ophthalmology, dermatology, ICU - Minimum 50 beds - Maximum population served: 1,000,000

Table 2: Health facilities studied in Kisumu and Siaya counties in Kenya; November 2013-January 2014

Type of Health Facility	Kisumu	Siaya	Total
Dispensary/Health Clinic (Level 2)	9	12	**21**
Health Center (Level 3)	6	3	**9**
Primary Hospitals (Level 4)	18	6	**25**
Secondary Hospitals (Level 5)	4	1	**5**
Total	**38**	**22**	**60**

Table 3: Functioning supplies and equipment at health facilities in Kisumu and Siaya, Kenya (number of facilities)

	Level 2 n=21 (%)	Level 3 n=9 (%)	Level 4 n=25 (%)	Level 5 n=5 (%)	Total n=60 (%)
General					
Gloves	20 (95)	7 (78)	24 (96)	5 (100)	56 (93)
Face masks	10 (48)	4 (44)	21 (84)	5 (100)	40 (67)
Gowns	3 (14)	4 (44)	17 (68)	5 (100)	29 (48)
Monitored beds	NA	NA	1 (4)	4 (80)	6 (10)
Central line kits	NA	NA	1 (4)	4 (80)	5 (8)
Suction	5 (24)	4 (44)	19 (76)	4 (80)	32 (53)
Blood pressure cuffs	18 (86)	6 (67)	23 (92)	5 (100)	52 (87)
Splint/cast supplies	2 (10)	1 (11)	14 (56)	4 (80)	21 (35)
Suture and wound-care supplies	18 (86)	8 (89)	23 (92)	5 (100)	54 (90)
Defibrillator	1 (5)	0 (0)	1 (4)	3 (60)	5 (8)
Back-up power	1 (5)	2 (22)	14 (56)	5 (100)	22 (42)
Chest tube trays	1 (5)	1 (11)	3 (12)	5 (100)	10 (17)

Laboratory/Diagnostics					
Ultrasound	1 (5)	0 (0)	9 (36)	5 (100)	15 (25)
ECG	0 (0)	1 (11)	3 (12)	3 (60)	8 (13)
X-ray	1 (5)	0 (0)	12 (48)	5 (100)	18 (30)
Otoscope	5 (24)	4 (44)	14 (56)	5 (100)	28 (47)
Ophthalmoscope	4 (19)	4 (44)	13 (52)	5 (100)	26 (43)
Glucometer	3 (14)	3 (33)	23 (92)	5 (100)	34 (57)
Medications					
Nitroglycerin	0 (0)	1 (11)	4 (16)	2 (40)	7 (12)
Antibiotics	16 (76)	8 (89)	22 (88)	5 (100)	51 (85)
Opiates	0 (0)	0 (0)	10 (40)	5 (100)	15 (25)
Insulin	4 (19)	1 (11)	19 (76)	5 (100)	29 (48)
Pressors	NA	NA	23 (92)	5 (100)	48 (80)
General and regional anesthesia	NA	NA	8 (32)	5 (100)	13 (22)
Airway/Breathing					
Oxygen	5 (24)	2 (22)	20 (80)	5 (100)	32 (53)

CPAP/BPAP machine	NA	NA	0 (0)	1 (20)	1 (2)
Ambubag	8 (38)	1 (11)	20 (80)	5 (100)	34 (57)
Intubation supplies	2 (10)	4 (44)	12 (48)	5 (100)	23 (38)

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. This study was funded internally and by in-kind donation by the authors' Division of Global Health and Human Rights at Massachusetts General Hospital.

Competing interests:

All of the authors have been formally queried, and no authors have competing interests with this study.

Data sharing statement: Extra data are available by emailing tfburke@partners.org.

Author contributions:

TFB was involved in study design, implementation, analysis, and writing of the manuscript. RA was involved in study analysis and writing of the manuscript. RA was involved in study design, implementation, analysis, and writing of the manuscript. MW, DY, REA, ST, RC, and WO were involved in study design and data collection. BDN was involved in study design, implementation, analysis, and writing of the manuscript. All authors have reviewed, edited, and approved the final submission. TFB takes responsibility for the paper as a whole.

References

1 World Health Organization. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization, 2010.

2 Peden M, McGee K, Sharma G. The injury chartbook: A graphical overview of the global burden of injuries. Geneva: World Health Organization, 2002.

3 Gosselin R, Spiegel D, Coughlin R, et al. Injuries: the neglected burden in developing countries. *Bulletin of the World Health Organization* 2009; **87**:246.

4 Mock C, Lormand JD, Goosen J, et al. Guidelines for essential trauma care. Geneva: World Health Organization, 2004.

5 Odhiambo FO, Beynon CM, Ogwang S, et al. Trauma-related mortality among adults in rural western Kenya: Characterising deaths using data from a health and demographic surveillance system. *PLoS ONE* 2013; **8**(11):e79840.

6 Ministry of Health, Government of Kenya. Guidelines for antiretroviral drug therapy in Kenya. 2011. Available at: http://www.who.int/hiv/pub/guidelines/kenya_art.pdf. Accessed 7 May 2014.

7 Ministry of Public Health and Sanitation. Guidelines on management of leprosy and tuberculosis. 2009. Available at: http://www.who.int/hiv/pub/guidelines/kenya_tb.pdf. Accessed 7 May 2014.

8 Baker T, Lugazia E, Eriksen J, et al. Emergency and critical care services in Tanzania: A survey of ten hospitals. *BMC Health Services Research* 2013; **13**:140.

9 Wallis LA, Garach SR, Kropman A. State of emergency medicine in South Africa. *Int J Emerg Med* 2008; **1**(2):69–71.

10 Wen LS, Oshiomogho JI, Eluwa GI, et al. Characteristics and capabilities of emergency departments in Abuja, Nigeria. *Emerg Med J* 2012; **29**(10):798–801.

11 Wachira BW, Wallis LA, Geduld H. An analysis of the clinical practice of emergency medicine in public emergency departments in Kenya. *Emerg Med J* 2012; **29**(6):473–6.

12 Mwaniki P, Ayieko P, Todd J, et al. Assessment of paediatric inpatient care during a multifaceted quality improvement intervention in Kenyan district hospitals: Use of prospectively collected case record data. *BMC Health Serv Res* 2014; **14**:312.

13 Irimu GW, Gathara D, Zurovac D, et al. Performance of health workers in the management of seriously sick children at a Kenyan tertiary hospital: Before and after a training intervention. *PLoS One* 2012; **7**(7):e39964.

14 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

15 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

16 Luoma M, Doherty J, Muchiri S, et al. August 2010. *Kenya Health System Assessment* 2010. Bethesda, MD: Health Systems 20/20 project, Abt Associates Inc.

17 World Health Organization. Guidelines for essential trauma care. Geneva, World Health Organization, 2004.

18 Razzak JA, Hyder AA, Akhtar T, et al. Assessing emergency medical care in low-income countries: A pilot study from Pakistan. *BMC Emergency Medicine* 2008; **8**:8.

19 Mock CN, Tiska M, Adu-Ampofo M, et al. Improvements in prehospital trauma care in an African country with no formal emergency medical services. *J Trauma* 2002; **53**(1): 90–7.

20 Samai O, Senegeh P. Facilitating emergency obstetrical care through transportation and communication, Bo, Sierra Leone. *International Journal of Gynecology and Obstetrics* 1997; 59 Suppl **2**:S157–64.

21 Calvello E, Reynolds T, Hirshon JM, Buckle C, Moresky R, O'Neill J, Wallis LA. Emergency care in sub-Saharan Africa: Results of a consensus conference. *African Journal of Emergency Medicine* 2013; **3**(1): 42–8.

Emergency and urgent care capacity in a resource-limited setting: an assessment of health facilities in western Kenya

Authors and affiliations

Thomas F. Burke, MD [a, b, c]

Rosemary Hines [a]

Roy Ahn, MPH, ScD [a, b, c]

Michelle Walters [a]

David Young, MD [a]

Rachel Eleanor Anderson, MD [a]

Sabrina Tom, MD [a]

Rachel Clark [a]

Walter Obita, MD [c]

Brett D. Nelson, MD, MPH [a, b, c]

a. Division of Global Health and Human Rights, Department of Emergency Medicine, Massachusetts General Hospital, Zero Emerson Place, Suite 104, Boston, MA 02114, USA

b. Harvard Medical School, 25 Shattuck St, Boston, MA 02115, USA

c. Sagam Community Hospital, Siaya Road, Luanda 50307, Kenya

Corresponding author:

Thomas F. Burke, MD, FACEP, FRSM

Division of Global Health and Human Rights, Massachusetts General Hospital

Zero Emerson Place, Suite 104, Boston, MA 02114, USA

E-mail tfburke@partners.org

Phone +1-617-584-0064

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. This study was funded internally and by in-kind donation by the authors' Division of Global Health and Human Rights at Massachusetts General Hospital.

Competing interests:

All of the authors have been formally queried, and no authors have competing interests with this study.

Data sharing statement: Extra data are available by emailing tfburke@partners.org.

Author contributions:

TFB was involved in study design, implementation, analysis, and writing of the manuscript. RA was involved in study analysis and writing of the manuscript. RA was involved in study design, implementation, analysis, and writing of the manuscript. MW, DY, REA, ST, RC, and WO were involved in study design and data collection. BDN was involved in study design,

implementation, analysis, and writing of the manuscript. All authors have reviewed, edited, and approved the final submission. TFB takes responsibility for the paper as a whole.

Word count:

2,9635~~53~~ words

Keywords:

Emergency medicine

Urgent care

Capacity assessment

Kenya

Pre-hospital care

Abstract

Objective: Injuries, trauma, and non-communicable diseases are responsible for a rising proportion of death and disability in low- and middle-income countries. Delivering effective emergency and urgent health care for these and other conditions in resource-limited settings is challenging. In this study, we sought to examine and characterize emergency and urgent care capacity in a resource-limited setting.

Methods: We conducted an assessment in western Kenya within all 30 primary and secondary hospitals and within a stratified random sampling of 30 dispensaries and health centers. Key informants were the most senior facility health care provider and manager available. Emergency physician researchers utilized a semi-structured assessment tool, and data were analyzed using descriptive statistics and thematic coding.

Results: No lower-level facilities and 30% of higher-level facilities reported having a defined, organized approach to trauma. Forty-three percent of higher-level facilities had~~ve~~ access to an anesthetist. The majority of lower-level facilities had~~ve~~ suture and wound care supplies and gloves but typically lacked other basic trauma supplies. For cardiac care, 50% of higher-level facilities had~~ve~~ morphine, but a minority had~~ve~~ functioning ECG, sublingual nitroglycerin, or defibrillator. Only 20% of lower-level facilities had~~ve~~ glucometers, and only 33% of higher-level facilities could~~an~~ care for diabetic emergencies. No facilities had~~ve~~ sepsis clinical guidelines.

Conclusions: Large gaps in essential emergency care capabilities were identified at all facility levels in western Kenya. There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.

Strengths and limitations of this study:

- This assessment was completed within all 30 primary and secondary hospitals and a stratified random sampling of 30 dispensaries and health centers in western Kenya
- Semi-structured interviews were conducted among facility leadership to examine and characterize emergency and urgent care capacity in this resource-limited setting
- Large gaps at all facility levels were identified in essential care capabilities
- There is great opportunity for a universally deployed basic emergency care package, advanced emergency care package and facility designation scheme, and reliable pre-hospital care transportation and communications system for resource-limited settings.
- The study may not be generalizable outside of this region.

Introduction

Background and importance

Providing effective emergency and urgent care is a considerable challenge in low- and middle-income countries. Difficulties exist with regard to transportation, communications, equipment, facility infrastructure, medication supply lines, affordability, and availability of skilled health care providers. Historically, infections caused by communicable diseases have been the major contributors to morbidity and mortality in resource-limited settings. However, traumatic injuries and non-communicable diseases (NCDs), such as heart disease and cancer, are rising rapidly and have recently become recognized as significant contributors to the burden of disease in developing countries. Eighty percent of all NCD deaths in 2008 (29 million) occurred in low- and middle-income countries, with cardiovascular disease, cancers, and respiratory disease the leading causes.[1] Furthermore, 16,000 people die globally each day from injuries alone, accounting for over 15% of the global burden of disease. Approximately 90% of these injuries occur in low- and middle-income countries.[2–4]

Kenya is facing an epidemic of NCDs and an increasing burden of injury and trauma. Between 2003 and 2008, the proportion of deaths related to trauma in western Kenya increased from 2.5% to 5·9%, with road traffic accidents (RTA) the leading cause.[5] In the past, most Kenya public health programs focused on communicable diseases. As a consequence, Kenya has developed disease-specific clinical guidelines for HIV/AIDS, malaria, tuberculosis, and other communicable diseases, but there are currently no national guidelines for emergency care.[6,7] As rates of NCDs and trauma-related injuries and deaths increase, there is a growing urgency to

provide adequate and organized treatment for time-sensitive illnesses and injuries, such as acute myocardial infarction, stroke, trauma, and sepsis.

Recent assessments performed in a select group of facilities in Nigeria, South Africa, and Tanzania documented emergency and critical care services in terms of resources, routines, and guidelines, while a small-scale evaluation of public emergency departments in Kenya described the most common diagnoses of presenting patients.[8–11] Other facility-level studies in Kenya have assessed inpatient care.[12,13] However, no assessment of the emergency care capabilities across a region in Kenya has ever been published.

Goals of this investigation

The Division of Global Health and Human Rights in the Department of Emergency Medicine at the Massachusetts General Hospital was approached by the Kenyan Ministry of Health and asked to assess the emergency and urgent health care capabilities across all levels of facilities in Kisumu and Siaya counties of western Kenya. This paper reports major findings from this assessment.

Health care provision in Kenya

Kenya has 6,626 health facilities across 47 counties, serving a population of over 43 million people. Kisumu and Siaya counties have populations of 968,909 (52% urban) and 842,304 (11% urban), respectively.[14,15] There are a total of 150 health facilities in Kisumu (92 public, 15 non-governmental, 15 faith-based, and 28 private) and a total of 162 health facilities in Siaya (115

public, 7 non-governmental, 17 faith-based, and 23 private). The Kenya Essential Package for Health (KEPH) defines the levels of care in Kenya: Level 1 for community-administered care and Levels 2-6 for health care facilities (Table 1).[16] Levels 2, 3, 4, 5, and 6 represent dispensaries and clinics, health centers, primary hospitals, secondary hospitals, and tertiary hospitals, respectively.

Methods

Study design and setting

This facility-based emergency care capabilities assessment was conducted between November 1, 2013 and January 20, 2014, in Kisumu and Siaya counties in western Kenya. All 30 Level 4 and 5 facilities in the two counties (there are no Level 6 facilities in these counties) were selected for assessment. Selection of 30 additional facilities occurred via randomized stratified sampling of each additional type of facility – dispensary, health center, and health clinic. The criterion for inclusion was an open healthcare facility currently providing health services; there were no restrictions based on geography or accessibility.

Methods and measurements

This facility-based emergency care capabilities assessment utilized semi-structured, key-informant interviews using a data collection instrument designed by the study authors. The key informants were the most senior institution staff members identified during the day of the assessment – typically the chief medical officer and/or senior administrator. The assessment tool drew from existing models of facility assessment in South Africa, Pakistan, and Tanzania, as

well as the WHO Guidelines for Essential Trauma Care.[9,10,17,18] The assessment tool was refined by expert consultation with the team's emergency physicians and public health epidemiologists, and covered eight domains: facility demographics, referral services, personnel, economics, supplies and laboratory, trauma, critical care, and anesthesia. The interviews consisted of open-response questions related to health care services, most common conditions of patients presenting for care, provider capabilities, equipment, supplies, and medications. Qualitative questions pertained to attitudes and perceptions related to provider morale, cooperation and communication between referring and receiving health facilities, and recommendations for continuing education and referral services.

The key-informant interviews were conducted by our field research team – consisting at all times of at least one emergency physician and one research assistant. Three different emergency physicians were involved throughout the data collection process. The delivery of questions and interview structure were discussed *a priori* by all three physician interviewers in order to standardize the interview process. Participants were provided an overview of the project, and the voluntary and confidential nature of the assessment was described. All participants gave verbal consent prior to participation.

Analysis

Data were analyzed using standard descriptive and frequency analyses, utilizing Microsoft Excel 2007 (Seattle, WA, USA). Qualitative research methods involved thematic analysis of interviews in order to best understand emergent findings.

Ethical review and funding

This study was reviewed and approved by the Institutional Review Board of Partners Healthcare (Boston, MA, USA) and the Ministry of Health of Kenya. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Results

A key informant at each of the 60 facilities was surveyed between November 1, 2013 and January 20, 2014. The facility sites were a mix of dispensaries/health clinics, health centers, primary hospitals, and secondary hospitals, as shown in Table 2. (There are no tertiary hospitals in Kisumu or Siaya County.) The 60 key informants comprised 10 chief medical officers (all at the hospital level), 39 nurse managers (facility matron), and 11 lead clinical officers.

Level 2 and 3 Facilities

Common Conditions

Key informants were asked by open response to list the 10 most common emergent and urgent conditions presenting to their health facility. The most frequently reported conditions at Level 2 and 3 facilities were (in ~~rank~~ order of reporting frequency) malaria (30 of ~~/~~30 facilities, 100%), diarrhea (26/30, 87%), upper respiratory infections (24/30, 80%), skin infections (18/30, 60%), sexually transmitted infections (15/30, 50%), pneumonia (14/30, 47%), and RTAs/trauma (9/30, 30%).

Trauma and Injury

When asked if their Level 2 and 3 facilities have a specific approach to a trauma patient that differs from how they approach a medical patient, 0% of key informants answered in the affirmative. In response to how well respondents felt their facility can handle major trauma, all 30 said they refer. Twenty-six (87%) of the 30 said they refer immediately, and four (13%) said they try to provide first aid then refer. The majority of providers (21/30, 70%) said their facility is poorly equipped to handle a broken bone.

The majority of Level 2 and 3 facilities had~~ve~~ suture and wound care supplies (26/30, 87%) and gloves (27/60, 90%) (Table 3). Few of these facilities had~~ve~~ oxygen (7/30, 23%) and splinting/casting supplies (3/30, 10%), and none had~~ve~~ blood for transfusion (0/30, 0%).

Critical Care

When asked about the standard procedure for treating someone with a possible heart attack, all 30 providers at Level 2 and 3 facilities reported that their facility refers. Eighteen (60%) of the 30 reported referring patients immediately, eight (27%) said they treat symptoms (e.g., painkillers, oxygen) and then refer, and four (13%) said they check vitals and then refer. Of the 30 Level 2 and 3 facilities, one had~~s~~ sublingual nitroglycerin.

The majority of providers (29/30, 93%) at the lower-level facilities said that their facility is ill-prepared to handle possible diabetic ketoacidosis (DKA) and must refer all cases. Overall, six (20%) Level 2 and 3 facilities had~~ve~~ a glucometer and five (17%) had~~ve~~ insulin.

In regards to a standard procedure for cases of possible sepsis, fifteen (50%) of the 30 providers at Level 2 and 3 facilities said they refer, 11 (37%) reported providing treatment without referral (e.g., antibiotics, IV fluids), and four (13%) providers said that they did not know how to approach sepsis. A majority of the Level 2 and 3 facilities (24/30, 80%) had~~ve~~ antibiotics.

Facility Levels 4 and 5

Common Conditions

The most frequently reported presenting emergent and urgent conditions at Level 4 and 5 facilities were similar to those at Level 2 and 3 facilities. They are (in ~~rank~~ order of reporting frequency)~~:~~ malaria (30/30, 100%), diarrhea (22/30, 73%), sexually transmitted infections (21/30, 70%), pneumonia (21/30, 70%), RTAs/trauma (18/30, 60%), and upper respiratory infections (16/30, 53%).

Trauma and Injury

Nine (30%) providers at Level 4 and 5 facilities reported that their facility has an organized approach to trauma (e.g., emergency team with assembly point). When asked if they are notified in advance of patients arriving to the hospital, four (13%) answered in the affirmative.

In review of basic trauma supplies in Level 4 and 5 facilities, 97% had~~ve~~ gloves, 93% had~~ve~~ suture and wound care materials, and 83% had~~ve~~ oxygen. All five of the Level 5 facilities had~~ve~~ chest tubes and x-ray capability, and four of the five had~~ve~~ splinting and casting supplies. Three (12%) of the 25 Level 4 facilities had~~ve~~ chest tubes and 12 (48%) had~~ve~~ x-ray capability. Sixteen

(64%) of the 25 Level 4 facilities, and all five of the Level 5 facilities had~~ve~~ blood available for transfusion. Seventeen (57%) providers at Level 4 and 5 facilities reported that their facility ~~does~~ did not have access to a trained provider that can administer general or regional anesthesia.

Critical Care

When asked about diagnosis and treatment of someone presenting with a possible acute myocardial infarction (AMI), 20 (80%) of 25 providers at level 4 hospitals reported that their facility refers; 11 (44%) reported that their facility stabilizes (e.g., oxygen or first aid) and then refers, and nine (30%) providers reported that their facility refers immediately. Five (20%) providers at Level 4 facilities reported that their facility provides diagnostic and treatment services without referral (e.g., ACE inhibitors, beta blockers, or aspirin). All 5 Level 5 facilities reported giving oxygen to suspected AMI patients, while three reported providing aspirin, two reported providing morphine and one reported providing epinephrine. Several of the Level 4 and 5 facilities were lacking in supplies and equipment to manage cardiac emergencies. Fifteen (50%) facilities had~~ve~~ morphine, six (20%) had~~ve~~ a functioning ECG machine, six (20%) had~~ve~~ nitroglycerin, and four (13%) had~~ve~~ a defibrillator.

Ten (33%) of 30 providers at Level 4 and 5 facilities reported that their facility is well-prepared to manage DKA. A majority of Level 4 and 5 facilities had~~ve~~ a glucometer (28/30, 93%) and insulin (24/30, 80%).

When asked about a standard procedure for cases of sepsis, the vast majority (29/30, 97%) of Level 4 and 5 facilities reported providing some treatment for sepsis (e.g., antibiotics, IV fluids), but none had standardized clinical care guidelines. Twenty-three (92%) of the 25 Level 4 and all five of the Level 5 facilities had~~ve~~ vasopressor agents. Twenty-two (88%) of the 25 Level 4 and all five of the Level 5 facilities had~~ve~~ antibiotics.

Discussion

With an increasing number of NCDs, RTAs, and other time-sensitive illnesses and injuries, the provision of emergency care in low-and middle-income countries is taking on increasing importance. Our study illustrates that essential emergency and urgent care is severely lacking in western Kenya. Limited communication, infrastructure, supplies, and properly trained human resources all negatively impact the ability to deliver quality emergency and urgent health care.

Although by definition Level 2 and Level 3 facilities in Kenya are not designed nor expected to provide comprehensive care for acutely ill patients, we elected to study their capabilities around emergency care since community members often present to them with acute life-threatening illnesses and injuries. We discovered that virtually all of the 30 Level 2 and 3 facilities we studied were unable to respond to the essential needs of patients presenting with acute trauma, a possible heart attack, diabetic emergencies, or sepsis. Most facilities reported transferring patients without even basic assessments or interventions. Few facilities had any organized approach in transferring a patient or notifying the receiving facility.

The authors view the Level 2 and 3 facility findings as a compelling call to action for the development of a contextually appropriate, standardized basic level training and materials package for emergency care. For example, a training program in the essentials of emergency care for Level 2 and 3 facilities should include the development of a standard approach to all acute care patients: basic assessment and intervention of airway, breathing, and circulation; taking and interpreting vital signs; methodical total body assessment; hemorrhage control; immobilization and splinting of potential injuries; capabilities of providing basic high-impact diagnostics and interventions (e.g., point-of-care glucose, ECG, aspirin, antibiotics, splints); and a pre-established reliable and rapid referral and notification plan.

While emergent and urgent conditions present frequently to Level 4 and 5 facilities, we discovered that the hospitals' capabilities varied considerably. While all of the 30 facilities had gaps across each of the domains we studied, many of the gaps at the Level 4 facilities were quite profound. Overall, some of the more salient findings in the Level 4 and 5 facilities' assessments were: 70% do not have a standardized approach to trauma, few have the basic materials necessary to manage trauma (e.g. chest tube, blood), less than half have a functioning x-ray machine, less than half (43%) of the operating theatres have access to an anesthetist, only six of 30 have EKG machines or nitroglycerin, most do not give aspirin for heart attacks, few are able to provide care for DKA, and no facility had a standardized approach to sepsis.

The findings from our Level 4 and Level 5 facility assessment demonstrate an urgent need for a system-wide intervention, targeting the unmet higher-level facility needs of the acutely ill and

injured. Many of the Level 4 and 5 facilities dide not meet the most basic standard for the essentials of emergency care delivery that we believe can – and should – be universally implemented at all lower-level facilities. We propose that in addition to every facility being brought up to the basic level, a second package in essentials of advanced emergency care should be developed and deployed to select Level 4 and 5 facilities. These selected facilities, once meeting standards for training, materials, and infrastructure, should then be designated and widely recognized and supported as *centers of excellence for advanced emergency care*, and thereby capable of providing quality assessment and initial stabilization of all emergent and urgent conditions.

Access to quality pre-hospital care services was universally poor in our study sample and can be seen as an opportunity for organization and improvement. A basic pre-hospital system should be created by establishing a mechanism to access reliable transportation staffed with personnel who have basic life-support skills. Elsewhere, it has been shown that training lay people in the community, such as community health workers or public transportation drivers to function as pre-hospital care providers, can greatly improve the quality of emergency care.[19] Additionally, a standardized communication method ought to be instituted. For example, in Sierra Leone, it has been shown that equipping remote health facilities and traditional birth attendants with radio receivers linked to referral hospitals can shorten response times and reduce maternal deaths.[20]

Although not addressed in this study, it is likely that these findings would be similar elsewhere across sub-Saharan Africa. If this assessment is indeed generalizable, the authors believe that the development of a set of standardized packages for basic and advanced essentials of emergency care in low-resource settings, as well as designating *centers of excellence for advanced emergency care,* should be a priority for the WHO and other stakeholders. The African Federation for Emergency Medicine has been developing consensus recommendations for emergency care packages for various facility levels.[21]

Our study had several limitations. Although we believe the lessons learned are representative of counties in Kenya and other low-resource settings globally, our findings are not definitively generalizable beyond the two counties surveyed. Furthermore, we recognize that elements of our survey may have been limited by social desirability bias. Although we tried to mitigate this with the confidential and voluntary nature of our survey and by explaining the purpose of our study, participants may not have felt comfortable reporting problems or inadequacies in their facilities. While our research staff included a local Kenyan who was present at all site visits and functioned as a language and cultural ambassador, language and cultural differences may have contributed to confounding variables. Furthermore, while informants were selected based on their senior leadership roles and expertise with the operations of their facility, their responses might not have always accurately reflected opinions of the majority of providers at the facility.

In conclusion, with an increasing epidemic of NCDs and an increasing burden of injury and trauma in low-resource areas, access to quality essential emergency and urgent care services is

critical for the health of surrounding communities. Our 60-facility assessment in western Kenya identified significant widespread gaps in current emergency care capabilities, particularly in identifying and appropriately caring for victims of trauma, acute myocardial infarction, diabetic emergencies, and sepsis. There is great opportunity for development of a universally deployed basic package in the essentials of emergency care, a selectively implemented package in the essentials of advanced emergency care, a center of excellence for emergency care facility designation scheme, and a reliable pre-hospital care transportation and communications system. Additionally, the profound gap in readily available trained anesthetists requires immediate attention.

Table 1: Description of levels of care in Kenya

Level 1	Community	- Care outside facility in households, communities, and villages - Maximum population served: 5,000
Level 2	Dispensaries/ Clinics	- Has limited staff (nurses, public health technicians, and assistants) - Responsible for community engagement through curative, promotive, preventive, and rehabilitative care at a basic level - Up to four beds for observation - Maximum population served: 10,000(rural) - 15,000(urban)
Level 3	Health Centers	- Staffed by nurses, clinical officers, and occasionally doctors - Wider range of curative and preventive services than Level 2 - Provide minor surgical services, like incision and drainage - Basic emergency preparedness - 12-49 beds - Maximum population served: 30,000-40,000
Level 4	Primary Hospitals	- Provide referral level outpatient care, curative and preventive care, surgical treatment techniques, and comprehensive emergency services - Provide clinical services in obstetrics and gynecology, child health, medicine, and surgery and anesthesia - Inpatient care and 24-hour service - Minimum 50 beds - Maximum population served: 100,000(rural) - 200,000(urban)

Level 5-6	Secondary/ Tertiary Hospitals	- Higher concentration of resources and personnel (medical professionals, nurses, and midwives) - Provide clinical services in medicine, general surgery and anesthesia, pediatrics, and obstetrics/gynecology, dental, psychiatry, comprehensive accident and emergency, ENT, ophthalmology, dermatology, ICU - Minimum 50 beds - Maximum population served: 1,000,000

Table 2: Health facilities studied in Kisumu and Siaya counties in Kenya; November 2013-January 2014

Type of Health Facility	Kisumu	Siaya	Total
Dispensary/Health Clinic (Level 2)	9	12	**21**
Health Center (Level 3)	6	3	**9**
Primary Hospitals (Level 4)	18	6	**25**
Secondary Hospitals (Level 5)	4	1	**5**
Total	**38**	**22**	**60**

Table 3: Functioning supplies and equipment at health facilities in Kisumu and Siaya, Kenya (number of facilities)

	Level 2 n=21 (%)	Level 3 n=9 (%)	Level 4 n=25 (%)	Level 5 n=5 (%)	Total n=60 (%)
General					
Gloves	20 (95)	7 (78)	24 (96)	5 (100)	56 (93)
Face masks	10 (48)	4 (44)	21 (84)	5 (100)	40 (67)
Gowns	3 (14)	4 (44)	17 (68)	5 (100)	29 (48)
Monitored beds	NA	NA	1 (4)	4 (80)	6 (10)
Central line kits	NA	NA	1 (4)	4 (80)	5 (8)
Suction	5 (24)	4 (44)	19 (76)	4 (80)	32 (53)
Blood pressure cuffs	18 (86)	6 (67)	23 (92)	5 (100)	52 (87)
Splint/cast supplies	2 (10)	1 (11)	14 (56)	4 (80)	21 (35)
Suture and wound-care supplies	18 (86)	8 (89)	23 (92)	5 (100)	54 (90)
Defibrillator	1 (5)	0 (0)	1 (4)	3 (60)	5 (8)
Back-up power	1 (5)	2 (22)	14 (56)	5 (100)	22 (42)
Chest tube trays	1 (5)	1 (11)	3 (12)	5 (100)	10 (17)

Laboratory/Diagnostics					
Ultrasound	1 (5)	0 (0)	9 (36)	5 (100)	15 (25)
ECG	0 (0)	1 (11)	3 (12)	3 (60)	8 (13)
X-ray	1 (5)	0 (0)	12 (48)	5 (100)	18 (30)
Otoscope	5 (24)	4 (44)	14 (56)	5 (100)	28 (47)
Ophthalmoscope	4 (19)	4 (44)	13 (52)	5 (100)	26 (43)
Glucometer	3 (14)	3 (33)	23 (92)	5 (100)	34 (57)
Medications					
Nitroglycerin	0 (0)	1 (11)	4 (16)	2 (40)	7 (12)
Antibiotics	16 (76)	8 (89)	22 (88)	5 (100)	51 (85)
Opiates	0 (0)	0 (0)	10 (40)	5 (100)	15 (25)
Insulin	4 (19)	1 (11)	19 (76)	5 (100)	29 (48)
Pressors	NA	NA	23 (92)	5 (100)	48 (80)
General and regional anesthesia	NA	NA	8 (32)	5 (100)	13 (22)
Airway/Breathing					
Oxygen	5 (24)	2 (22)	20 (80)	5 (100)	32 (53)

CPAP/BPAP machine	NA	NA	0 (0)	1 (20)	1 (2)
Ambubag	8 (38)	1 (11)	20 (80)	5 (100)	34 (57)
Intubation supplies	2 (10)	4 (44)	12 (48)	5 (100)	23 (38)

References

1 World Health Organization. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization, 2010.

2 Peden M, McGee K, Sharma G. The injury chartbook: A graphical overview of the global burden of injuries. Geneva: World Health Organization, 2002.

3 Gosselin R, Spiegel D, Coughlin R, et al. Injuries: the neglected burden in developing countries. *Bulletin of the World Health Organization* 2009; **87**:246.

4 Mock C, Lormand JD, Goosen J, et al. Guidelines for essential trauma care. Geneva: World Health Organization, 2004.

5 Odhiambo FO, Beynon CM, Ogwang S, et al. Trauma-related mortality among adults in rural western Kenya: Characterising deaths using data from a health and demographic surveillance system. *PLoS ONE* 2013; **8**(11):e79840.

6 Ministry of Health, Government of Kenya. Guidelines for antiretroviral drug therapy in Kenya. 2011. Available at: http://www.who.int/hiv/pub/guidelines/kenya_art.pdf. Accessed 7 May 2014.

7 Ministry of Public Health and Sanitation. Guidelines on management of leprosy and tuberculosis. 2009. Available at: http://www.who.int/hiv/pub/guidelines/kenya_tb.pdf. Accessed 7 May 2014.

8 Baker T, Lugazia E, Eriksen J, et al. Emergency and critical care services in Tanzania: A survey of ten hospitals. *BMC Health Services Research* 2013; **13**:140.

9 Wallis LA, Garach SR, Kropman A. State of emergency medicine in South Africa. *Int J Emerg Med* 2008; **1**(2):69–71.

10 Wen LS, Oshiomogho JI, Eluwa GI, et al. Characteristics and capabilities of emergency departments in Abuja, Nigeria. *Emerg Med J* 2012; **29**(10):798–801.

11 Wachira BW, Wallis LA, Geduld H. An analysis of the clinical practice of emergency medicine in public emergency departments in Kenya. *Emerg Med J* 2012; **29**(6):473–6.

12 Mwaniki P, Ayieko P, Todd J, et al. Assessment of paediatric inpatient care during a multifaceted quality improvement intervention in Kenyan district hospitals: Use of prospectively collected case record data. *BMC Health Serv Res* 2014; **14**:312.

13 Irimu GW, Gathara D, Zurovac D, et al. Performance of health workers in the management of seriously sick children at a Kenyan tertiary hospital: Before and after a training intervention. *PLoS One* 2012; **7**(7):e39964.

14 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

15 Commission on Revenue Allocation (2011) Kenya County Fact Sheets. Available at: http://siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/Kenya_County_Fact_Sheets_Dec2011.pdf. Accessed 7 May 2014.

16 Luoma M, Doherty J, Muchiri S, et al. August 2010. *Kenya Health System Assessment* 2010. Bethesda, MD: Health Systems 20/20 project, Abt Associates Inc.

17 World Health Organization. Guidelines for essential trauma care. Geneva, World Health Organization, 2004.

18 Razzak JA, Hyder AA, Akhtar T, et al. Assessing emergency medical care in low-income countries: A pilot study from Pakistan. *BMC Emergency Medicine* 2008; **8**:8.

19 Mock CN, Tiska M, Adu-Ampofo M, et al. Improvements in prehospital trauma care in an African country with no formal emergency medical services. *J Trauma* 2002; **53**(1): 90–7.

20 Samai O, Senegeh P. Facilitating emergency obstetrical care through transportation and communication, Bo, Sierra Leone. *International Journal of Gynecology and Obstetrics* 1997; 59 Suppl **2**:S157–64.

21 Calvello E, Reynolds T, Hirshon JM, Buckle C, Moresky R, O'Neill J, Wallis LA. Emergency care in sub-Saharan Africa: Results of a consensus conference. *African Journal of Emergency Medicine* 2013; **3**(1): 42–8.