Commentary

Emergency care systems in Africa: A focus on quality

V.C. Kannan[a],[*], A. Tenner[b], H.R. Sawe[c], M. Osiro[d], T. Kyobe[e], E. Nahayo[f], N.G. Rasamimanana[g], S. Kivlehan[h], R. Moresky[i]

[a] Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA
[b] University of California San Francisco, San Francisco, CA, USA
[c] Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania
[d] Department of Emergency Medical Services, Ministry of Health, Uganda
[e] Association of Ambulance Professionals Uganda, Kampala, Uganda
[f] Emergency Department, Centre Hospitalier Universitaire de Kigali, Rwanda
[g] University Hospital of Mahajanga P-ZAGA, Mahajanga, Madagascar
[h] Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA
[i] Columbia Mailman School of Public Health, New York, NY, USA

ARTICLE INFO

ABSTRACT

Emergency care systems (ECS) are undergoing a period of rapid development on the African continent. What were formerly large intake zones are now being shaped into dedicated emergency units. Emergency care providers are being trained via certificate and even residency programs. However, significant challenges still exist. Resource limitations, staffing, and other system inputs are often the easiest issues to identify, but they only account for part of the problem. There are other prominent barriers to the delivery of high quality emergency care including lack of governmental leadership, poor system and facility organization, lack of provider training, and community misunderstanding of ECS functions. Released in May 2019, World Health Assembly (WHA) 72 resolution 12.9 "Emergency care systems for universal health coverage: ensuring timely care for the acutely ill and injured" has squarely placed ECS strengthening as a priority item to member state governments. Moving forward, it will be important to ensure that these systems are set up for success, as high-quality emergency care systems have the potential to avert half of all deaths in low- and middle-income countries (LMIC). With momentum building from the recent WHA amendment and the health systems community more focused than ever on the consideration of quality in health systems design, it is of the utmost importance that ECS planners dovetail these interests such that these nascent systems are designed while 1) applying a systems thinking lens and 2) maintaining a focus on quality. This article helps to accomplish this by breaking down ECS into five major categories for evaluation as defined by the WHO Emergency Care Systems Assessment tool, providing an understanding of the functions of each, and identifying which indicators might be used to gauge performance. We also reinforce the notion that these indicators must dive deeper than system inputs and health outcomes, they must be patient centered in order to truly be reflective of success.

African relevance

- This manuscript serves as a road map to guide emergency care systems researchers in assessing African emergency care systems using the architecture of the World Health Organization Emergency Care System Assessment Tool (ECSA), which has been widely used in Africa.
- Case reports from countries across the African continent are used to illustrate improvement across each ECSA major category, and serve to ground the theoretical health systems discussions in the real-world.

- The authors' varied backgrounds provide multiple different perspectives on approaching systems evaluation including hospital management, academia, government, and the private sector.

Introduction

Emergency care systems (ECS) are undergoing a period of rapid development on the African continent. What were formerly large intake zones are now being shaped into dedicated emergency units. Emergency care providers are being trained via certificate and even

---

residency programs. Prehospital systems are taking the place of what were once simple transport vehicles [1]. However, significant challenges still exist. Resource limitations, staffing, and other system inputs are often the most commonly identified issues, but they only account for part of the problem [2]. There are other prominent barriers to the delivery of high quality emergency care including lack of governmental leadership, poor system and facility organization, lack of provider training, and community misunderstanding of ECS functions. Released in May 2019, World Health Assembly (WHA) 72 resolution 12.9 "Emergency care systems for universal health coverage: ensuring timely care for the acutely ill and injured" has squarely placed ECS strengthening as a priority item to member state governments. Moving forward, it will be important to ensure that these systems are set up for success, as high-quality emergency care systems have the potential to avert half of all deaths in low- and middle-income countries (LMIC). In this article, we discuss what constitutes a *high-quality* emergency care system.

Defining the "emergency care system"

WHA 72 resolution 12.9 defines emergency care as "an integrated platform for delivering accessible, quality, time-sensitive health care services for acute illness and injury across the life course" [3]. Emergency care systems are those elements of the health system that are integrated to link these undifferentiated patients to the immediate care that they need. ECS are comprised of more than just materials, infrastructure, and a human workforce. The effective management of time-sensitive conditions also requires certain policies and procedures be in place ahead of time so that care can be delivered in an organized manner and without delay.

Through an extensive consensus process, WHO has developed an ECS Framework that outlines the essential components of an emergency care system. Subsequently, an Emergency Care System Assessment (ECSA) tool was developed that allows countries to evaluate their ECS and set priorities for improvement. The ECSA breaks down emergency care systems into five major categories for evaluation:

1. Governance and Financing
2. Emergency Care Data and Quality Improvement
3. Scene Care, Transport and Transfer
4. Facility-Based Care
5. Emergency Preparedness

As the ECSA was developed to evaluate the function of each of the components of the ECS Framework at a systems level, it logically forms a roadmap to guide our discussion on quality. Prior to following this roadmap, one should first understand how and why we have begun to think beyond improving the quality of clinical care and consider the health system as a whole, what a "high quality" health system consists of, and how to assess emergency care system quality.

The evolution towards systems thinking: more than service delivery

Early systematic examination of health-care quality began with the work of Avedis Donabedian, whose 1966 article proposed a framework for quality of care assessment [4]. This framework described quality along the three categories of structure, process, and outcomes of care. In 2000 the Institute of Medicine (IOM) built upon the Donabedian foundation, positing that health systems should seek to improve performance on six dimensions of quality of care: safety, effectiveness,

patient-centeredness, timeliness, efficiency, and equity [5]. These approaches were immensely useful in evaluating and improving the quality of care, but were highly oriented towards service delivery.

As health systems research evolved, criticism arose that existing frameworks missed the human factor of people centeredness - civil society, consumers, communities, households, and individuals. They also lacked system interconnectedness, not only the supply side but also in terms of the population and components being coordinated or integrated [6]. Current thinking about high quality health systems is that they should be evaluated not only on their impact on improving health, but also on building confidence in the health system, creating a positive user experience, generating economic benefit, and improving the process of care [2]. We now understand that service delivery is only one of the building blocks of a health system, and we must make efforts to apply this "systems thinking" mindset when evaluating emergency care systems.

What is a high quality health system?

Health systems are complex adaptive systems made up of multilevel, interdisciplinary components that can often be difficult to understand. To help with this, a number of "quality frameworks" have been developed. They offer a perspective from which to view the healthcare system, breaking it down into easily digestible parts and ensuring that key factors are taken into consideration when assessing quality.

The quality movement saw major advances in 2019 with the publication of three landmark frameworks on global health quality: 1) a joint effort between WHO, World Bank, and Organization for Economic Co-operation and Development titled "Delivering quality health services: a global imperative for universal health coverage", 2) the IOM report "Crossing the Global Quality Chasm: Improving Health Care Worldwide" and 3) The Lancet Global Health Commission on High-Quality Health Systems in the SDG Era [2]. The Lancet Commission offers the simplest definition three, defining a high-quality system as "*one that optimizes health care in a given context by consistently delivering care that improves or maintains health outcomes, by being valued and trusted by all people, and by responding to changing population needs.*" It articulates that without a focus on improving health system quality (not only the quality of care delivery, or of disease-specific targets) we will not succeed in meeting the Sustainable Development Goals.

How do you assess the quality of an emergency care system?

The National Institute of Health Fogarty International Center convened the Collaborative on Enhancing Emergency Care Research in LMICs (CLEER), and tasked the group with applying 'systems thinking' to identify key ECS research gaps and questions with the potential to inform the development of effective, equitable and high quality emergency care [7]. The group ultimately developed an emergency care system research framework which had four aims: (1) to improve our understanding of what ECS are and how they operate, (2) to determine what interventions improve both the public health impact and address the wider social value of ECS, (3) to identify cost-effective interventions that can be integrated at different levels of ECS, and (4) to develop and implement interventions that achieve and enhance access to respectful, high-quality care and improve health outcomes (Fig. 1).

It is with these frameworks and a renewed focus on quality in mind that we now break down emergency care systems into their component parts as defined by the five ECSA major categories, discussing example indicators one might examine when assessing each.
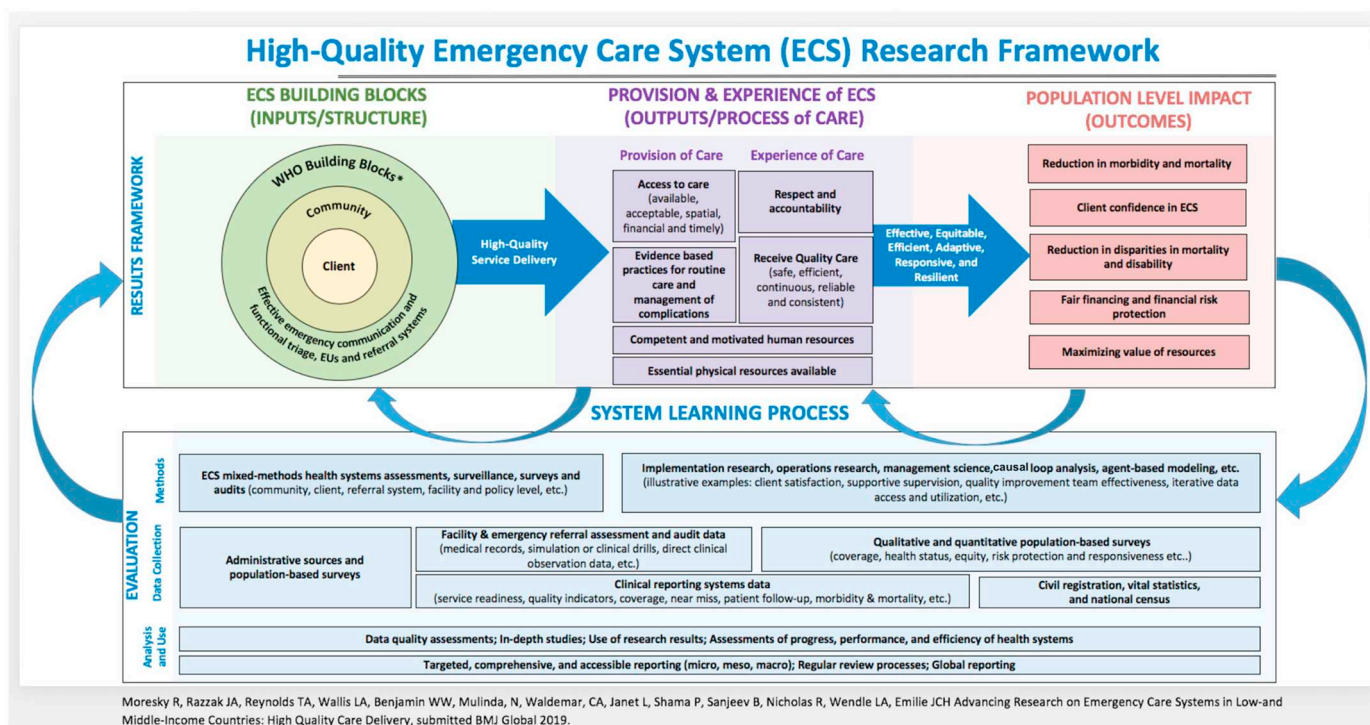
Fig. 1. NIH CLEER research framework.

The components of a high quality emergency care system

1. System organization, governance and financing

WHA 72 resolution 12.9 posits that ECS governance mechanisms should coordinate "routine prehospital and hospital-based emergency care services, including linkage with other relevant actors for disaster and outbreak preparedness and response, including the capacity of personnel in other sectors" and that financing mechanisms should "create policies for sustainable funding, effective governance and universal access to safe, high-quality, needs-based emergency care for all, without regard to sociocultural factors, without requirement for payment prior to care, and within a broader health system that provides quality essential care and services and financial risk protection as part of universal health coverage". (Operative Paragraphs 2.11 and 3.6).

In addition to these priorities, it is important to ensure that the resulting system is organized in such a way that emergency care facilities are present in sufficient number, are equipped at adequate level, and are distributed in such a way that access to them is possible for persons in both urban and rural settings. It is equally important legislation is enacted to ensure that when these persons seek out care (at both the pre-hospital and facility level) they are guaranteed the access and financial protection required to see it delivered. A high-quality governing and finance structure will have readily appreciable indicators reflecting both the burden on the government and the burden on the people. For example, governmental indicators might be the presence of a line-item in the budget dedicating funding for emergency care and legislation protecting patients from being required to pay before being treated, and civilian indicators might be the tracking of catastrophic and impoverishing health expenditures.

The advocacy required to meet these goals can be long and arduous, but persistence is rewarded, as demonstrated by the following case study from Uganda:

Case study – Uganda

Martha Osiro – Technical Assistant, Ugandan Ministry of Health

Background

Uganda has a nascent emergency care system challenged by limited medical supplies and equipment, inadequately trained personnel, and poor infrastructure. The health system structure in Uganda is comprised of Health Centres I to IV, General Hospitals, Regional Referral Hospitals, and finally National Referral Hospitals. When asked of their capacity to provide emergency care, only 5% of hospitals and health center IV's were classified as "very good", and only 25% were "good" [8]. Scarce medical supplies and skilled emergency care providers were cited as significant barriers. Only 64% of emergency medical service provision is funded by the government, with the remainder coming from a combination of NGOs, charity organizations, members of parliament and private facilities. However, a lack of system inputs was only part of the problem.

Implementation of an emergency care system in Uganda

Attempts to implement an emergency care system begin in 2007 heeding the directive of World Health Assembly (WHA) resolution 60.22, calling on member states to establish and monitor integrated emergency care systems. These early attempts were unfortunately met with little buy-in from stakeholders, largely due to the fact that not many people understood what "emergency care" is. Many believed it referred to ambulance and other pre-hospital services.

These divergent views were resolved when the Ministry of Health worked with WHO to conduct a system-level assessment using the ECSA in 2017. The stakeholders that participated in the ECSA came from all sectors – there were members from the Ministry of Health (MOH), Office of the Prime Minister, Ambulance Providers, Educational Institutions, Uganda Police Force, medical professionals from both Public and Private facilities, Kampala Capital City Authorities and Uganda Peoples

Defence Forces. This multidisciplinary approach ensured buy-in from the members present, ultimately making them ambassadors to advocate for ECS development in their various arenas. Indeed, the ECSA provided a framework from which the development of Emergency Care Systems in Uganda would be realized.

Thus far, this dialogue has led to the many changes:

- A Department of Emergency Medical Services (EMS) was created within MOH
- A National Policy on Emergency Medical Services will soon become law
- A National Costing Assessment was conducted
- The Regulatory Impact Assessment (RIA) was conducted, quantifying the cost benefit of having an ECS
- An emergency care services access number (912) was acquired from the Uganda Communication Cooperation
- An Ambulance Association was convened, bringing together public and private ambulance providers
- Data elements for emergency care indicators were incorporated in the HMIS
- Provisions for Emergency Care Services were added to the National Health Insurance Scheme
- Standards and Guidelines for pre-hospital care were developed
- Curricula for Emergency Nurses and Emergency Medical Technicians were developed
- The University of Makerere and Mbarara created residency training programs for emergency physicians

Uganda continues to make steady progress in the development of its emergency care system. Our experience highlights the importance of assessing one's system and developing strategies that are context-specific. Those working to develop emergency medical services here can say without a doubt that Uganda is succeeding.

2. Emergency care data and quality improvement.

Emergency care data are of critical importance in improving the quality of care delivery both at the facility and system level. Data pertinent to emergency care delivery can originate from a variety of sources including pre-hospital records, police reports, hospital records, mortuary records, death certificates, community-based surveys, and even insurance company reports. The quality of these data is of critical importance, as an abundance of low-quality data will be of little utility in identifying gaps in care or targeting areas for improvement. One form of data quality control comes in the form of standardized clinical charts, which can also serve a clinical function in reinforcing a standardized approach to every patient. A successful emergency care system will gather data from multiple if not all of these sources and link them together in a manner that allows for *continuous* quality improvement at both the facility and systems levels. These data should include (but are not limited to) demographic information, past medical history, scene and prehospital care, facility care, diagnosis, severity, and disposition. Facility process metrics, in particular the timing of interventions, are also of particular importance as the time-sensitivity of emergency conditions is a key differentiator between the ECS and the health system at-large. Indicators regarding emergency care data should reflect these priorities and might include: quantitative data on the number and frequency of source data linkages, breadth of data points covered, and time metrics.

Electronic health records, though they require significant adaptation by providers, can improve patient care and are the future of medical records. Incorporating emergency care visits into the EHR is a crucial component of quality improvement, as many conditions that are responsive to quality emergency care may not manifest a perceivable morbidity or mortality benefit until the inpatient component of a patient's visit. Many nascent emergency care systems do not have routine

or standardized documentation for emergency visits, and when present these records are often not linked to inpatient charts. This disconnects hamstrings quality improvement efforts. Examples of such efforts include morbidity and mortality conferences, preventable death panel reviews, audit filter screenings, assessing adherence to guidelines and protocols, and provider-specific targeted actions.

Furthermore, it is important that inputs from the emergency department are not only fed into downstream records at a single facility, but are also aggregated and incorporated into system-wide quality improvement efforts. These linkages, and the impacts they are used to evaluate should be a routine component of a healthcare system's quality improvement plan.

Accordingly, indicators regarding quality improvement should describe the frequency and standardization of emergency unit documentation and its linkage to inpatient records. They should also cover guideline and protocol adherence, quantity of positive audit filter flags, and morbidity and mortality statistics. There is no firm consensus around which conditions most accurately reflect high quality emergency care delivery. Carr, et al. have called for research to identify "emergency care sensitive conditions", but acknowledge these likely vary by geographic location and economic stratum [9]. While numerous single-site examples exist (outlined below in the facility-based care section), there is no validated set of conditions or indicators for regions on the scale of an entire African ECS, and this should be a key priority for researchers moving forward.

Still, progress can be made with the tools we have. The following case study from Madagascar shows the power of data in improving care for the injured.

Case study

Dr. Giannie Rasamimanana – Chief of Service, Emergency and Intensive Care Unit, University Hospital of Mahajanga P-ZAGA

Background

The burden of injury is high in Madagascar, accounting for 10% of overall mortality according to its 2014 WHO country profile. Addressing this burden requires the use of reliable and accessible data, which has proven challenging in the Malagasy context. Single facility ad hoc reports from the Hopital Universitaire Joseph Ravoahangy Adrianavalona have been successful, but systems level data has proven more elusive. A 2017 national survey of pediatric injury was able to obtain epidemiologic information on an estimated 87% of injured children presenting to Basic Health Centers from 22 regions, but unfortunately was not able to capture and aggregate any data whatsoever from district or university-level hospitals [10]. In short, data are insufficient in breadth and are not obtainable in timely fashion, limiting their utility in decision-making.

WHO International Registry for Trauma and Emergency Care (IRTEC)

The University Hospital of Mahajanga P-ZAGA is a regional referral hospital in the province of Mahajanga in Northwestern Madagascar. Trauma our most common presenting illness, with injured patients arriving from many regions including the Boeny, Menabe, Betsiboka and beyond. Recognizing that trauma is highly amenable to data-driven quality improvement processes, in September 2018 we implemented the WHO International Registry for Trauma and Emergency Care. The implementation required several key actions. First, we cross-referenced our existing patient documentation template with the core data elements of the WHO Dataset for Emergency Care, to identify which fields we needed to incorporate into our documentation. Then, we trained our staff in how to properly fill out this new chart, with particular emphasis on *why* this change was needed, to increase buy-in at the ground level. Finally, we devised a sustainable mechanism for data entry by integrating this process into the weekly workflow of our emergency interns. During the first quarter of data collection we observed 532 patient visits. Our goal in using the IRTEC was to identify potentially preventable deaths,

and we succeeded. Our audit filters flagged 9 cases with dyspnea and 7 cases of hypoxia that did not receive any supplemental oxygen, 6 cases of severely depressed mental status that did not receive airway support, and 1 patient who presented with a low injury severity score (and therefore low predicted mortality) who died. The registry flags cases in which death or a poor outcome may have been avoidable, we then use these flags to perform quality improvement programs, and ultimately lives are saved.

Limitations

Implementing such complex data systems in the LMIC context will always be challenging. We experienced two barriers in particular worth mention. First, our preexisting internet connectivity was unreliable, and often absent altogether. To mitigate this, we used a USB modem with high speed connection dedicated specifically for this project. Second, provider turnover is common in the emergency department, where we lack dedicated personnel. Our interns rotate twice a month. This turnover required repeated trainings on how to properly fill out the data fields on our modified patient documentation. We were able to address this by assigning the task of intern training to staff members who were permanently assigned to the emergency department.

Conclusion

The WHO IRTEC is well adapted to the LMIC context, and has helped us with a range of internal quality improvement processes including protocol updates and targeted provider training, as well as building our research capacity. It is built on a software platform that is familiar to our ministry-level colleagues, and we hope this will facilitate scaling to the national level so that we can expand our efforts from CHU P-ZAGA to the Malagasy emergency care system as a whole.

3. Scene care, transport and transfer.

Most emergency care begins at the scene and is often initially provided by untrained bystanders while awaiting the arrival of professional responders [11]. A high-quality prehospital system supports a tiered approach to scene care that invests in both lay and professional rescuers through legislation, public education, and targeted trainings [12]. Laws protecting these lay rescuers encourage early scene care without fear of legal consequences and have been implemented in many countries. Simple trainings targeting workers in high risk professions (i.e. factory workers) or civilians likely to have high exposure to emergencies (i.e. taxi drivers or sports coaches) have been successfully implemented in diverse settings [12]. Just-in-time pre-arrival instructions provided to bystanders by dispatchers can further increase early access to care.

A well-designed prehospital system is built on a centralized communications structure that allows the public to easily access the emergency care systems through a simple and free phone number [13,14]. Resources are coordinated in real time by a dispatcher, with ambulances scheduled and prepositioned based on historical data trends [15]. Professional responders should be trained in accordance with regional care standards and protocols, have access to medical direction both on- and off-line, and be certified by an appropriate regional body [16]. Standards and protocols should be developed in coordination with facilities and providers which receive emergency patients to ensure continuity of care [12].

In addition to bringing emergency care directly to the patient in the scene, a quality prehospital system allows for care to continue seamlessly from the scene throughout transport to an appropriate facility. Ambulances should be equipped with standard supplies and certified by a central accrediting body. Emergency care supplies should be portable and durable, able to be brought directly to the patient on scene as well as inside the ambulance [17]. Minimum staffing standards for ambulances call for at least two personnel: a driver and a provider that remains with the patient at all times. This staffing ensures that patient care continues uninterrupted during transfer. There should also be protocols in place that guide the use of destination triage. Destination triage is the selection of the destination facility not only by proximity but by the level of specialized services based on an assessment of patient needs. For certain conditions (such as severe trauma), patients have been shown to have improved outcomes when they are preferentially taken to a center of excellence for their condition [18,19]. However, over-triaging can also place undue burden on facilities [20]. Thus a measure of quality would include a standardized system to ensure that prehospital providers determine the appropriate destination for patients. Ambulances should be equipped with a method of communicating status and location with the dispatcher at all times, which may take the form of a radio or GPS system.

Documentation is a crucial component of the prehospital system. Every patient encounter should be recorded, including assessment findings and interventions performed, using a standardized form. A copy of this documentation should be given to the receiving facility upon patient handoff, which should always occur verbally and face-to-face upon facility arrival. Data generated from patient encounters and other ambulance activities should be collected in a central registry that allows for quality improvement and ongoing system assessment of the key indicators of prehospital care [16,21,22]. Efforts should be made to protect personal health data both in real-time communication and in documentation.

When considering the implementation of these system components, local context and acceptance must be considered. Public outreach programs can develop an understanding of barriers to implementation, and allow for regional modifications to improve acceptability. Needs assessments should be performed to understand the regional emergency care system, such as facility capabilities and capacity, telecommunications availability, and road transportation functionality [23,24]. Furthermore, there are multiple ways to achieve this and solutions can and indeed should be context-specific. Both the private and public sectors have found roles to play, as evidenced by the following two case studies:

Case study - private sector

Tom Bazanye Kyobe – President, Association of Ambulance Professionals Uganda

Prior to forming the Association of Ambulance Professionals Uganda (AAPU) I spent 11 years working as part of an ambulance crew. Along the way, my colleagues and I noted that most ambulance personnel were, by profession, drivers. Former taxi drivers were the most common as they are adept at navigating the chaotic streets of Uganda. Upon becoming ambulance drivers they received no formal training in patient care. They were, in essence, transporters.

Recognizing the need for the development of a professional cadre of ambulance personnel, beholden to certain standards, the AAPU was formed. The initial working group was comprised of founders, instructors and staff of both private (UGAMBULA, Ambulance Africa, Saint John Ambulance, City Ambulance Ltd) and former public (Ugandan National Ambulance Service) ambulance providers, as well as members of the Ugandan Police and Red Cross.

The group's first activity was to convene a group of 29 key stakeholders representing public and private hospitals, transport companies, and the Ministry of Health to hold a one day strategic planning meeting with an associated basic trauma care training. The meeting served several key functions. First, it provided a desperately needed training. Second, it gave the group access to future trainings that were heretofore financially inaccessible. Third, it allowed the group to set priorities including the need for national standards for ambulance personnel. And finally, by coming together as a group to advocate for such standards, the group gained a voice.

This voice did not go unnoticed. The Ministry of Health began engaging AAPU in activities ranging from prehospital workshops to consensus building around emergency care indicators to be included in the country's health management information

---

systems. Malteser International recruited them to develop the "Emergency Care Assistant" prehospital provider curriculum, partnered with the Ministry of Education and Directorate of Industrial Training. And finally, AAPU has found itself in a co-ordinating role, connecting patients in need of scene and inter-facility transport to available ambulance providers in a country that currently lacks a central coordinator or universal access telephone number.

AAPU's vital role in Ugandan prehospital care is becoming more cemented every day. No governmental branch is prepared to absorb its range of services, and these services are growing in scope every day. Our case serves to highlight the impact a mo-tivated group of individuals can make on prehospital care at the national level.

Case study - public sector
Dr. Ernest Nahayo – President, Rwanda Emergency Care Association

Background
Rwanda's unique hilly topography presents a logistical chal-lenge to emergency care access, particularly for the 84% of its population that live in rural areas. To help meet their needs, Rwanda began the pilot Pre-Hospital Emergency Care Services (PHECS) program in 2007, with the public branch of these ser-vices, Service d'Aide Médicale d'Urgence (SAMU), founded in 2008.

Evolution
SAMU began as a small program with only 90 ambulances, and grew rapidly to 225 ambulances by 2016 (five per district) yielding one ambulance per 48,000 people – exceeding the WHO recommendation of 1 ambulance per 50,000 people. It operates via a national emergency call center (toll-free 912 number)covers every region of the country, including water ambulances in all districts with islands (such as Lake Kivu), and even some air ambulances. It plays a significant role in intervening in obstetric emergencies, injuries (particularly road traffic injuries), and medical emergencies. It has demonstrated its capability even in times of disaster such as emergency evacuations of Rwandans in the East African Community region and rescue activities during natural disasters (e.g. earthquakes, bushfires) and disease out-breaks (e.g. avian influenza).

Future Directions
SAMU is also being continuously expanded and upgraded through human and financial capacity-building and simulation exercises with key partners such as the MCI and airport emer-gency rescue system. However, challenges remain. The opera-tional costs of the program are very high due to Rwanda's terrain, requiring frequent maintenance and repairs for breakdowns. The program aims to become 100% self-funded to improve its au-tonomy, but this has yet to be realized. It also aims to install technology capable of recording field data, standardizing services throughout the country, establishing a monitoring and evaluation framework, and building human resource capacity through pre-hospital courses and masters level programs in emergency med-icine.

Conclusion
With emergency medicine still a nascent field in Rwanda, building a widespread, comprehensive, technologically advanced, and financially sustainable and self-reliant PHECS system is an enormous goal. However, with Rwanda's significant progress in human resource, supply, and financial capacity-building in the past decade, PHECS in Rwanda has been built on a strong foun-dation to construct a promising future.

4. Facility-based care

In Africa, facility-based emergency care systems are rapidly evol-ving, despite being a relatively new concept in many countries. They are now more and more recognized as essential components of the health care systems that support the prevention of death and life long disability. The provision of facility-based emergency care needs ongoing quality assessment of emergency care delivery as an essential component of improvement of the care provision. Several indicators for assessment of facility-based care have been developed to support clin-icians and policy makers to measure and improve the quality of emergency care delivered at facility level. As previously discussed in the Emergency Care Data and Quality Improvement section, these in-dicators may vary by geographic location and economic stratum. In the following discussion we review a case report from Tanzania:

Case study
Dr. Hendry Sawe, Chief Medical Officer, Muhimbili National Hospital Emergency Department

We have developed a strong literature base supporting the use of the following indicators from our experience in strengthening our facility-based emergency care capacity in Tanzania:

1. *Morbidity and Mortality* from different clinical conditions are some of the most frequent indicators used in assessing dif-ferent interventions within the emergency care systems. *Broccoli MC,* et al, performed multiphase expert consensus process to identify, rank and refine quality indicators to determine which will allow uniform and objective data collection for emergency care systems in Africa [21]. In this extensive process they found that mortality from different clinical conditions (*ex:* mortality in trauma patients within 24 h of emergency unit (EU) presentation, or transfusion rate among eligible trauma patients presenting to EU) can easily be studied and indicate the quality of care delivery in the EU. In Tanzania, *Shari CR* et al. studied emergency blood transfusion practices among anaemic children presenting to an urban emergency department of a tertiary hospital in which he enrolled under five children who met the world health organization criteria for emergency transfusion [25]. Forty-nine percent of children with anaemia had indications for blood transfusion, but only 23% were transfused in the EU, and those not transfused had nearly a 3-fold higher mortality. This study provided insight into some of the areas of quality improvement within the EU including training providers on identification of anaemia, ordering blood, and linkages with the hospital blood bank system.
2. *Access to emergency care* as an indicator of emergency care system, can be used at all levels of emergency care system, but particularly at the facility level. Time to triage, time to first provider assessment, time to antibiotics in sepsis, time to operation theatre in ruptured ectopic pregnancy or pro-portion of patients leaving the EU without being seen can all be used to indicate the quality of emergency care delivery at a facility level. For example, when Ouma PO et al. examined a geocoded inventory of hospital services in Africa in rela-tion to how populations might access emergency care ser-vices, they found that 29% of people are located more than 2 h travel time from the nearest hospitals, concluding that physical access to facility-based emergency hospital care in Africa remains poor and varies substantially within and be-tween countries [26].
3. *Emergency unit structure and infrastructure* is an important quality indicator that has been studied in different parts of Africa. The availability of specific infrastructure for EU care, for example the presence of designated areas for triage, high acuity care, and low acuity care can provide insight into how well facility-based emergency care is functioning. In a study by *Koka* et al in Tanzania assessing the state of disaster preparedness and response capacity among Tanzanian re-gional hospitals, designated triage area for everyday use was available in only 40% of the hospitals [27].
4. *Client confidence in ECS* has been proposed as an indicator that speaks to the aforementioned "human element" that is often missing in quality assessments that traditionally focused on system inputs and disease outcomes. In a study conducted in Ethiopia, *Worku M* et al assessed client satisfaction on

---

emergency department services in Southern Ethiopia and found a low level of patient satisfaction in pharmacy services specifically due to unavailability of drugs [28].

5. *Clinical assessment and diagnostics* indicators such as the number of patients receiving a particular point of care diagnostic testing (example proportion of women of reproductive age receiving urinary pregnancy test in the EU, or Number of patients with trauma that have documented primary survey) have also been proposed.

5. Emergency preparedness

The final component of a robust ECS is its ability to respond to surge. Measures of quality in this realm include an evaluation of the capacity to mobilize resources and a comprehensive disaster plan. Resource mobilization is essential because, depending on the type and severity of the disaster, it is often not be feasible for individual facilities to be fully stocked with equipment for all disasters at all times [29]. Thus a system of resource reallocation during a crisis becomes very important, and this system should have some redundancy built in so that an event is less likely to take out all possible sources of the needed resource.

Given the nature of surge events, there is rarely time to prepare and quick action is essential early on to save lives during a time when the system infrastructure may not be functioning. Thus a robust disaster plan should be developed and in place to try to mitigate the effects of the event and should include human resource considerations, communication needs, equipment needs, clinical special requirements, and alternate transport mechanisms.

Case study

Drs. Hendry Sawe, Andrea Tenner, Juma Mfinanga, and Sherin Kassamali from Muhimbili National Hospital Emergency Department

The Emergency Medicine Department (EMD) at Muhimbili National Hospital serves a large primary patient population in Tanzania's largest city, Dar es Salaam, as well as a vast referral network from the remainder of the country. As such, it is positioned to be a key player in many disaster scenarios. Since the opening of the EMD there have been a number of disasters including explosions, sinking vessels, flooding, building collapses, and car accidents. These events drove the development of the EMD Disaster Protocol – standardizing our approach to all mass casualty incidents and preparing our EMD for the surge of patients associated with these events.

We have since had the opportunity to study the effects of this protocol on processes and outcomes during mass casualty incidents over time. We have performed a rigorous qualitative analysis of this process that will be published as a separate manuscript, in which we found significant improvements: 1) in the initial notification that the event had occurred, 2) in the communication between the EMD and other departments, and 3) in the triage processes post-implementation. We also found potential areas for improvement in pre-hospital coordination and equipment stocking. Our experience shows that by maintaining a focus on quality in this aspect of our emergency care system via iterative study and refinement of our EMD Disaster Protocol we have truly achieved a measurable success.

Summary

We are at a critical point in the course of African emergency care systems development. With momentum building from the recent WHA amendment on emergency care and the health systems community more focused than ever on the consideration of quality in health

systems design, it is of the utmost importance that ECS planners dovetail these interests such that these nascent systems are designed while 1) applying a systems thinking lens and 2) maintaining a focus on quality. We hope that this article will help to accomplish this by breaking down the ECS into easily digestible parts using the 5 major ECSA categories, help provide an understanding of the functions of each, and identify which indicators might be used to gauge performance. We also hope to reinforce the notion that these indicators must touch on deeper levels than system inputs and health outcomes in order to truly be reflective of success.

Author's contribution

Declaration of competing interest

The authors declare no conflicts of interest.

References

[1] Calvello EJB, Tenner AG, Broccoli MC, Skog AP, Muck AE, Tupesis JP, et al. Operationalising emergency care delivery in sub-Saharan Africa: consensus-based recommendations for healthcare facilities. Emerg. Med. J. 2016 Aug 1;33(8):573–80.

2. High-quality health systems in the sustainable development goals era: time for a revolution - Lancet Glob. Health [Internet]. [cited 2019 Sep 5]. Available from: https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(18)30386-3/fulltext.

3. Emergency care systems for universal health coverage: ensuring timely care for the acutely ill and injured. World Health Organization; 2019.

4. Donabedian A. Evaluating the quality of medical care. 1966. Milbank Q 2005;83(4):691–729.

[5] Institute of Medicine (US) Committee on Quality of Health Care in America. Crossing the quality chasm: A new health system for the 21st century [internet]. Washington (DC): National Academies Press (US); 2001 Available from http://www.ncbi.nlm.nih.gov/books/NBK222274/.

[6] Frenk J. The Global Health system: strengthening National Health Systems as the next step for global progress. PLoS Med. 2010 Jan 12;7(1) [Internet]. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2797599/.

[7] Moresky RT, Razzak J, Reynolds T, Wallis LA, Wachira BW, Nyirenda M, et al. Advancing research on emergency care systems in low-income and middle-income countries: ensuring high-quality care delivery systems. BMJ Glob. Health 2019 Jul 1;4(Suppl. 6):e001265.

8. Uganda Hospital and Health Center IV (HC IVs) Census Survey 2014. Uganda Ministry of Health; 2014.

9. Defining the emergency care sensitive condition: A health policy research agenda in emergency medicine | request PDF [internet]. ResearchGate. [cited 2019 Sep 5]. Available from: https://www.researchgate.net/publication/40833674_Defining_the_Emergency_Care_Sensitive_Condition_A_Health_Policy_Research_Agenda_in_Emergency_Medicine.

[10] Rakotoarison R, Rakotomavo F, Rafanomezantsoa T, Razafimahandry H, Raveloson N. Les accidents collectifs par accident de circulation vus aux Urgences. Rev Trop Chir 2014;8:34–6.

[11] Balhara KS, Bustamante ND, Selvam A, Winders WT, Coker A, Trehan I, et al. Bystander assistance for trauma victims in low- and middle-income countries: a systematic review of prevalence and training interventions. Prehosp Emerg Care 2019 May 4;23(3):389–410.

12. Pre-hospital and emergency care | DCP3 [Internet]. [cited 2019 Sep 5]. Available from. http://www.dcp-3.org/chapter/1789/pre-hospital-and-emergency-care.

[13] Reynolds TA, Calvello EJB, Broccoli MC, Sawe HR, Mould-Millman N-K, Teklu S, et al. AFEM consensus conference 2013 summary: emergency care in Africa – where are we now? Afr J Emerg Med 2014 Sep 1;4(3):158–63.

[14] Stein C, Mould-Millman N-K, De Vries S, Wallis L. Access to out-of-hospital emergency care in Africa: consensus conference recommendations. Afr J Emerg Med 2016 Sep 1;6(3):158–61.

[15] Mould-Millman N-K, de Vries S, Stein C, Kafwamfwa M, Dixon J, Yancey A, et al. Developing emergency medical dispatch systems in Africa – recommendations of the African Federation for Emergency Medicine/International Academies of Emergency Dispatch Working Group. Afr J Emerg Med 2015 Sep 1;5(3):141–7.

[16] Howard I, Cameron P, Wallis L, Castren M, Lindstrom V. Quality indicators for

evaluating prehospital emergency care: a scoping review. Prehospital Disaster Med 2018 Feb;33(1):43–52.

[17] Sasser S, Varghese M, Kellermann AL, Lormand J. Prehospital trauma care systems. World Health Organization; 2005.

[18] MacKenzie EJ, Rivara FP, Jurkovich GJ, Nathens AB, Frey KP, Egleston BL, et al. A National Evaluation of the effect of trauma-center care on mortality. N. Engl. J. Med. 2006 Jan 26;354(4):366–78.

[19] Staudenmayer K, Weiser TG, Maggio PM, Spain DA, Hsia RY. Trauma center care is associated with reduced readmissions after injury. J. Trauma Acute Care Surg. 2016 Mar;80(3):412.

[20] Newgard CD, Staudenmayer K, Hsia RY, Mann NC, Bulger EM, Holmes JF, et al. The cost of overtriage: more than one-third of low-risk injured patients were taken to major trauma centers. Health Aff Proj Hope 2013 Sep;32(9):1591–9.

[21] Broccoli MC, Moresky R, Dixon J, Muya I, Taubman C, Wallis LA, et al. Defining quality indicators for emergency care delivery: findings of an expert consensus process by emergency care practitioners in Africa. BMJ Glob. Health 2018 Feb 1;3(1):e000479.

[22] Nadarajan GD, Tiah L, Ho AFW, Azazh A, Castren MK, Chong SL, et al. Global resuscitation alliance utstein recommendations for developing emergency care systems to improve cardiac arrest survival. Resuscitation 2018 Nov 1;132:85–9.

[23] Kironji AG, Hodkinson P, de Ramirez SS, Anest T, Wallis L, Razzak J, et al. Identifying barriers for out of hospital emergency care in low and low-middle income countries: a systematic review. BMC Health Serv. Res. 2018 Apr 19;18(1):291.

24. EMS Systems in Lower-Middle Income Countries: A literature review | Suryanto | request PDF [internet]. ResearchGate. [cited 2019 Sep 5]. Available from: https://www.researchgate.net/publication/303674049_EMS_Systems_in_Lower-Middle_Income_Countries_A_Literature_Review.

[25] Shari CR, Sawe HR, Murray BL, Mwafongo VG, Mfinanga JA, Runyon MS. Emergency blood transfusion practices among anaemic children presenting to an urban emergency department of a tertiary hospital in Tanzania. BMC Hematol 2017 Nov 10;17(1):19.

[26] Ouma PO, Maina J, Thuranira PN, Macharia PM, Alegana VA, English M, et al. Access to emergency hospital care provided by the public sector in sub-Saharan Africa in 2015: a geocoded inventory and spatial analysis. Lancet Glob. Health 2018;6(3):e342–50.

[27] Koka PM, Sawe HR, Mbaya KR, Kilindimo SS, Mfinanga JA, Mwafongo VG, et al. Disaster preparedness and response capacity of regional hospitals in Tanzania: a descriptive cross-sectional study. BMC Health Serv. Res. 2018 Nov 6;18(1):835.

[28] Worku M, Loha E. Assessment of client satisfaction on emergency department services in Hawassa University referral hospital, Hawassa, southern Ethiopia. BMC Emerg Med 2017 Jun 27;17(1):21.

[29] Timbie JW, Ringel JS, Fox DS, Pillemer F, Waxman DA, Moore M, et al. Systematic review of strategies to manage and allocate scarce resources during mass casualty events. Ann. Emerg. Med. 2013 Jun 1;61(6):677–689.e101.