


Designing, Implementing, and Managing a National Emergency Medical Service in Sierra Leone

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Abbreviations:

EMS: Emergency Medical Service
GPS: global positioning system
HQ: headquarter
LIC: low-income country
MOHS: Ministry of Health and Sanitation
NEMS: National Emergency Medical Service
OC: operation center
PHU: Peripheral Health Unit
SOP: standard operating procedure
TM: Training Manager

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Abstract

Sierra Leone is one of the least developed low-income countries (LICs), slowly recovering from the effects of a devastating civil war and an Ebola outbreak. The health care system is characterized by chronic shortage of skilled human resources, equipment, and essential medicines. The referral system is weak and vulnerable, with 75% of the country having insufficient access to essential health care. Consequently, Sierra Leone has the highest maternal and child mortality rates in the world. This manuscript describes the implementation of a National Emergency Medical Service (NEMS), a project aiming to create the first prehospital emergency medical system in the country. In 2017, a joint venture of Doctors with Africa (CUAMM), Veneto Region, and Research Center in Emergency and Disaster Medicine (CRIMEDIM) was developed to support the Ministry of Health and Sanitation (MOHS) in designing and managing the NEMS system, one of the very few structured, fully equipped, and free-of-charge prehospital service in the African continent. The NEMS design was the result of an in-depth research phase that included a preliminary assessment, literature review, and consultations with key stakeholders and managers of similar systems in other African countries. From May 27, 2019, after a timeframe of six months in which all the districts have been progressively trained and made operational, the NEMS became operative at national level. By the end of March 2020, the NEMS operation center (OC) and the 81 ambulances dispatched on the ground handled a total number of 36,814 emergency calls, 35,493 missions, and 31,036 referrals.

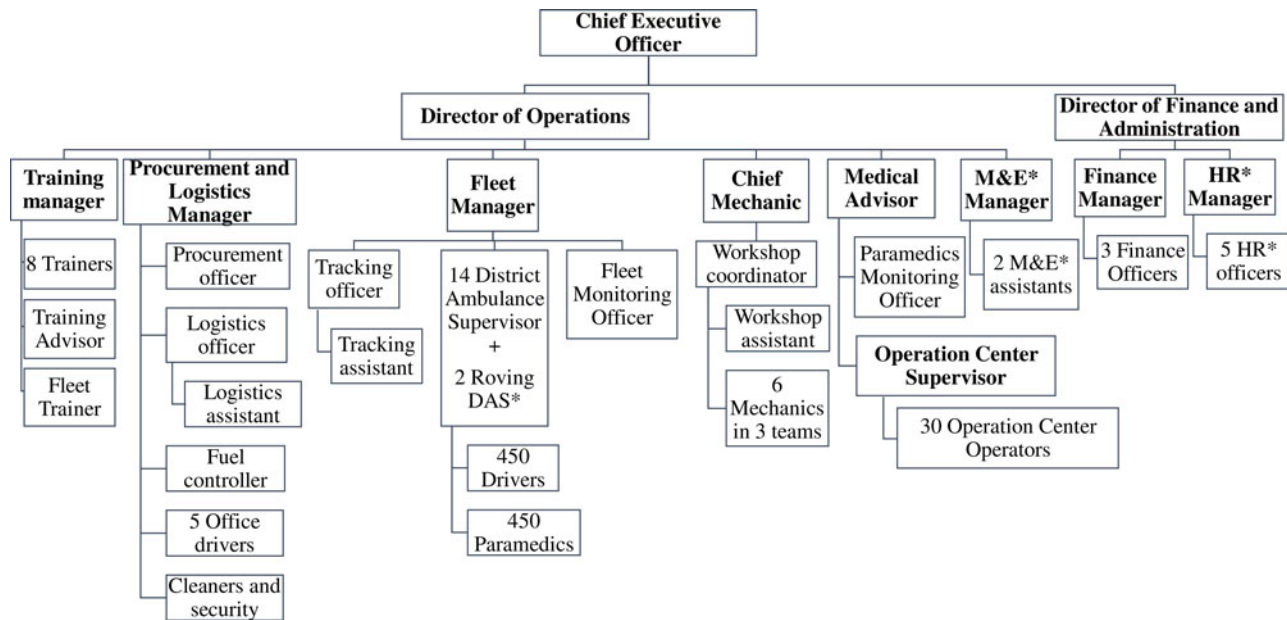
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Introduction

Sierra Leone can be classified as a challenging operating environment. It has a long historical and geopolitical context of poverty, and it displays the characteristics of a country that is recovering from disasters, such as the prolonged 11-year civil war that ended in 2002 and the Ebola outbreak in 2014.¹ The Human Development Index rank for Sierra Leone is 181 out of 189 countries, classifying it as one of the poorest low-income countries (LIC) world-wide.²

For many years after the civil war, the health system has remained weak and vulnerable to epidemics that tested the responsiveness and resilience of the country.³ A number of systemic issues have remained unaddressed for a long time, namely a chronic shortage of skilled human resources, gaps in the quality of health care, and common stock-outs of essential medicines.^{4–6} Seventy-five percent of the country has insufficient access to surgical care, with rural access zones having a ratio of 1:467,929.⁵ Moreover, as most of the African countries, Sierra Leone was devoid of any formalized prehospital care service.⁷ This scenario has lent itself to poor health system performance and poor health outcomes, with Sierra Leone having one of the highest maternal and newborn mortality rates in the world.⁸

Against this background, in 2015, the Government of Sierra Leone had set out the new priorities in the Recovery and Transition Plan, including the revitalization of the national ambulance service.⁹ With seed funding from the World Bank (Washington, DC USA), the Sierra Leone Ministry of Health and Sanitation (MOHS; Freetown, Sierra Leone) expressed the will to establish a National Emergency Medical Service (NEMS) using part of the ambulances procured during the Ebola outbreak. In response



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Figure 1. NEMS Organizational Structure.

Abbreviations: DAS, District Ambulance Supervisor; HR, human resources; M&E, monitoring and evaluating; NEMS, National Emergency Medical Services.

to this call, Doctors with Africa (CUAMM; Padua, Italy), the Research Center in Emergency and Disaster Medicine (CRIMEDIM; Novara, Italy) of the Università del Piemonte Orientale, and Veneto Region (Venice, Italy) proposed a joint venture to support the MOHS in designing, implementing, and managing the NEMS in the country within an expected timeframe of two years. At the end of the two-year work plan, the MOHS renewed the collaboration to implement a shadowing and training period to release a fully staffed, equipped, and functional NEMS working all over Sierra Leone, providing the citizens of Sierra Leone with prompt, safe, and effective access to the health care system in times of urgent needs. The NEMS represents one of the very few structured, adequately resourced, and free-of-charge Emergency Medical Services (EMS) in the African continent. The aim of this manuscript is to describe the implementation of the NEMS and to outline the innovative methodologies that have been applied to accomplish a considerable advancement of the emergency medical care services in the country in the benefit of its people.

Report

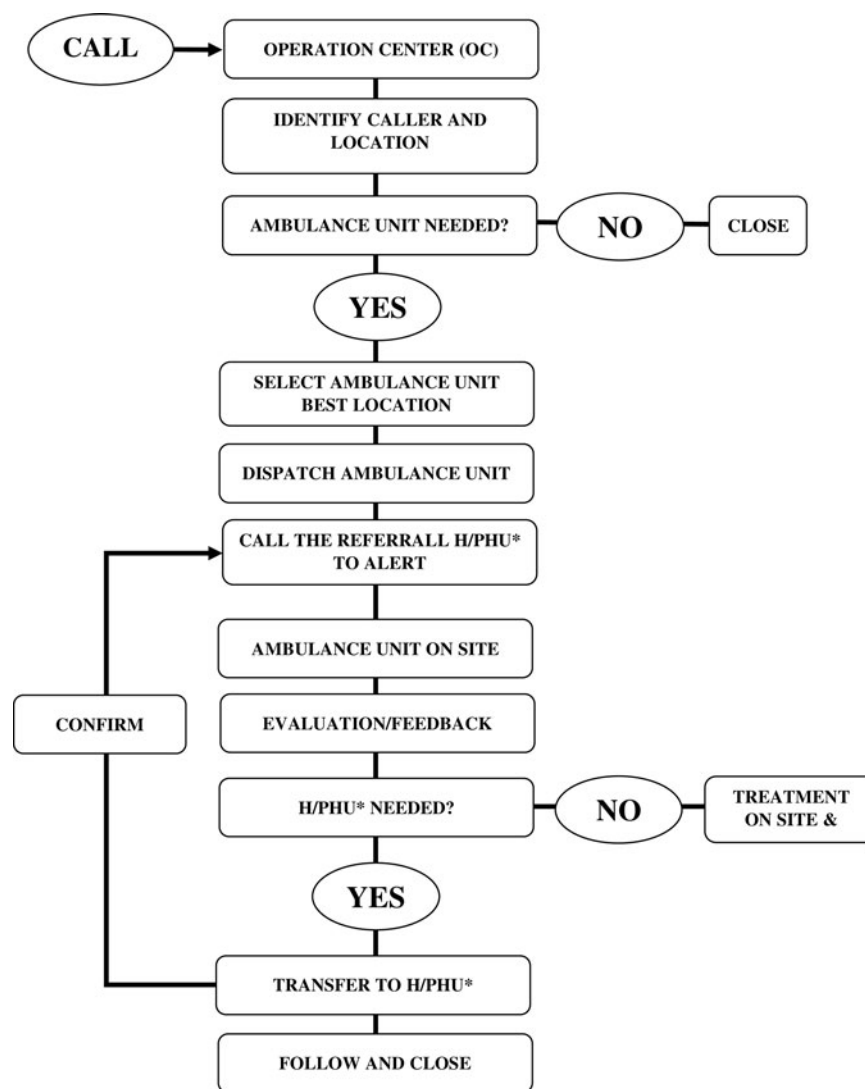
Design

The joint venture envisioned the NEMS as a network of coordinated EMS aiming to provide prehospital care involving personnel trained in the stabilization, transportation, and initial treatment of traumatic and medical emergencies. Despite the World Health Organization (Geneva, Switzerland) recent efforts to develop a standardized framework for emergency care systems, at the time of the design, no widely accepted method existed for implementing EMS in either developed or developing settings.¹⁰ Therefore, a scoping review was performed of peer-reviewed and non-peer-reviewed “grey” literature to understand the state of the art of similar EMS systems currently working in Africa and in other comparable settings across the world.^{11–22}

Results highlighted some common key issues that needed to be addressed to establish a well-structured EMS in such environments, namely the availability of skilled human resources, formal prehospital care training programs, quality monitoring systems, funding, and maintenance issues. Furthermore, consultations were conducted with local stakeholders and members of the board of the National Ambulance System of Uganda and Ghana to seek advice on the preliminary NEMS design. According to the preliminary evaluation and study, the NEMS was devised taking into consideration the current barriers that patients must overcome to access care, in terms of availability, affordability, and geographical accessibility.

From an architectural point of view, the NEMS was designed to include one headquarter (HQ), one operation center (OC), 14 district offices, and one garage. Figure 1 shows the complete organigram of NEMS.

The NEMS is a tiered system of care, which in a first phase is initiated by one of the 1,160 different Peripheral Health Unit facilities (PHUs) spread in the country, responsible for the primary assessment of patients that allows the OC to understand whether further care is required or not. All PHUs have a catchment area of few communities and are usually easy to reach by the population. Their role is to provide various levels of basic care according to the different resources and staff available, ranging from low-skilled health care workers to nurses and midwives. Prior to the implementation of NEMS, maps with the exact location of both villages and health facilities were either unavailable, approximate, or outdated. Through the collaboration with MOHS and accessing data from Sierra Leone Statistics (Freetown, Sierra Leone) and World Food Program (Rome, Italy), a comprehensive list was elaborated of all the health facilities involved in the NEMS service, subsequently refined through a global positioning system (GPS) tracker. Furthermore, in Sierra Leone, multiple rural villages share the same name, thus



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Figure 2. NEMS Call Taking Procedure.

Abbreviations: H/PHU, Hospital/Peripheral Health Unit; NEMS, National Emergency Medical Services.

hampering the correct identification of a specific location. This can be further complicated by spelling mistakes, different pronunciations, and the use of local dialects, leading to potential life-threatening errors during the emergency response. Therefore, a unique code has been assigned and distributed to each health facility included in the NEMS database, allowing smooth communication between the health care personnel and the OC, and ensuring a precise localization of the emergency scene. In a two-year span, the number of health facilities mapped and coded by NEMS reached a total of 1,378.

Subsequent stages of the response include the emergency medical dispatch of ambulance units to ensure timely and medically-appropriate responses to each request for prehospital care and medical transportation to the nearest district hospital. At a later stage, NEMS activation will be initiated by citizen action in the form of a telephone call to a toll-free three-digit emergency number.

On a routine basis, the NEMS provides medical care to Sierra Leone's citizens through the OC, a centralized office based at the

HQ consisting of devices, information systems, and human resources able to manage emergency phone calls 24 hours a day, seven days a week. Figure 2 shows the management of an emergency call.

The initial phases of call taking and triage are managed through an in-house developed software for aided dispatching, mission monitoring, and data collection. The software has a user-friendly interface that facilitates the learning process for the OC operators and constitutes the key data collector and management tool of the entire NEMS, resulting in a comprehensive and accurate database. Other technologies include a vehicle fleet management and GPS tracking system as well as an open-source private branch exchange software for the management of the calls in the OC room. All these systems generate data on the operational activities which represent the unique sources of information available at the national level on EMS.

Ambulance allocation across the country plays a major role in the emergency response. The final distribution of the ambulances has been a result of an in-depth study to define the number of

ambulances to allocate per district as well as their precise location. Ambulance distribution was based on population density and the dimension of the geographical area covered to guarantee an acceptable response time. To this regard, the dimension of the area was increased by 15% in those districts with poor road conditions. Moreover, the system has been foreseen to guarantee at least 20% of vehicles kept as spare for a prompt replacement in case of emergency. It is worth mentioning that the distribution of the ambulances was constantly monitored and revised, and slight changes have been introduced based on the OC software data to promote a more even distribution of the workload across the NEMS fleet. The creation of an in-house centralized garage fully equipped and run by a qualified team of mechanics has been crucial to guarantee a fully functioning fleet, considering the high number of ambulances to manage and the high cost and low liability of contracting out maintenance services. Additional to the main garage in Freetown, two teams of mechanics have been equipped with a mobile workstation for routine service and extraordinary maintenance in emergency cases.

Implementation and Management

During the first six months, tasks have been undertaken by the appropriate officers to organize the HQ offices and infrastructure, setup the information and technology aspects, establish inventory of ambulances and preparing the national fleet to meet the set standards, develop of the clinical standard operating procedures (SOPs) for the ambulance teams and other health practitioners involved in the NEMS, setup and equip the OC, and facilitate human and funding resources for the operation of the NEMS system. Given that one of the objectives of this joint venture was to allow the NEMS system to sustain its operations beyond the two-year initial period, a structured process of know-how transfer was carried out to local officials. In addition, the joint venture helped identify costs and advocated for the project to be incorporated in the governmental budget to guarantee the financial sustainability of the service. This is important because the NEMS is a brand-new service in Sierra Leone, which will enrich the MOHS health service package, but will also incur costs. While the first 26 months of the project have been financed solely by the World Bank, the subsequent stage will be funded through the governmental budget, an important achievement that confirms the full recognition of the success of NEMS at the governmental level.

Education and Training

Designated in-service training sessions based on a hybrid learning methodology provided paramedics, drivers, and OC operators with a common background, competencies, and proper attitude needed to work proficiently and effectively for the NEMS system. To achieve the expected goal, the joined venture followed the six-step approach to curriculum and training development, with the utmost learning objective to improve the technical and attitudinal performance of the trainees, instead of their mere knowledge.²³ The learning approach was based on modern theory of adult learning combining traditional and innovative teaching methodologies, such as practical exercises, group work and discussion, and live simulations using high-fidelity mannequins and actors. A Training Manager (TM) was appointed to coordinate and evaluate the NEMS Basic Course, and to lead on the assessment of the learning process to ensure all staff were effective and operating safely. Eight local trainers were selected

among candidates with health background and previous training experience and exposed to a two-week intensive course that enabled them to plan and organize a NEMS Basic Course (Table 1). Supported by an international task force of health care providers and under the coordination of the TM, the Local Training Team was held accountable for the training of paramedics, ambulance drivers, and OC operators.

Preliminary Outcomes

From October 2018, in a time span of eight months, all the districts of the country have been trained and subsequently made operational. In May 2019, NEMS became fully operative at a national level, with 80 ambulances, 450 certified paramedics, and 450 certified drivers. According to the data collected from December 1, 2018 through March 31, 2020 in the OC database, a total number of 36,814 emergency calls, 35,493 missions, and 31,036 referrals have been handled by the NEMS. Of note, 92% of hospital visits in the main receiving facilities occurred through NEMS ambulances. Most missions' complaints pertained to the obstetrics and gynecology area, accounting for the 49% of the total (Figure 3). Pediatric emergencies represented the second most frequent complaint, whereas the "other" category grouped all the remaining types of complaint, namely trauma including road accidents, loss of consciousness, abdominal pain, seizures, and breathing problems.

Discussion and Conclusions

The NEMS represents one of the very few structured, fully equipped, and free-of-charge prehospital service in the African continent. Its implementation is of paramount importance for Sierra Leone, one of the poorest LICs striving to enhance its health care system to improve the availability and the quality of medical assistance to the citizens and primarily to the vulnerable groups represented by the obstetric and pediatric population. Comparing to the few other existing prehospital referral systems in Africa, NEMS' strengths lie in the presence of extensive SOPs, well-established communication flow, structured data collection system, and continuing education programs.^{24,25} In this manuscript, the design and implementation phases of NEMS are described, a process that was not exempt from challenges, including lack of experience of local staff, paucity of information related to existing health care facilities, and poor condition of available vehicles. Moreover, problems had to be tackled related to the development of a brand new EMS from scratch, that needed to be properly integrated in the current National Health System and widely accepted by a population that experienced the stigma and fear associated with ambulances during the ravaging Ebola epidemic.²⁶ Organization of NEMS opening ceremonies at the district level and proper information sharing on NEMS positive outcomes represented key elements in gaining both the trust of hospital staff and the population. The authors firmly believe that sharing their experience could serve as a guide to support other LICs to develop similar projects. On-going further studies will analyze specific outputs and outcomes of NEMS to better understand its impact on the health care system of Sierra Leone.

Author Contributions

Luca Ragazzoni conceived the presented idea, participated in the initial design of the project, drafted the article, and provided final approval of the version to be submitted. Marta Caviglia

Module	Content	Recipient
1. Preparatory	<ul style="list-style-type: none"> • NEMS system • Role and the working principles of the ambulance unit and the operation center (OC) • Safety and well-being of the staff • Legal and ethical issues • Basic anatomy and physiology • Techniques of lifting and moving patients 	Paramedics, Ambulance Drivers, OC Operators
2. Adult and Pediatric Basic Life Support (BLS)	<ul style="list-style-type: none"> • Adult and pediatric BLS (2015 American Heart Association guidelines) 	
3. Airway Management	<ul style="list-style-type: none"> • Anatomy • Basic airway management techniques • Oxygen and oxygen equipment 	
4. Patient Assessment	<ul style="list-style-type: none"> • Medical and trauma patients • Vital signs assessment • Patient history • Documentation • Communication 	
5. Medical Emergencies	<ul style="list-style-type: none"> • Respiratory emergencies • Cardiac emergencies • Infectious diseases • Diabetes • Seizures • Poisoning and overdose 	
6. Trauma Emergencies	<ul style="list-style-type: none"> • Soft tissue and musculoskeletal injuries • Injuries to the head, neck, spine, chest, and abdomen 	
7. Obstetrics and Gynecology Emergencies	<ul style="list-style-type: none"> • Normal and abnormal deliveries • Neonatal resuscitation • Gynecological emergencies 	
8. Infants & Children	<ul style="list-style-type: none"> • Physical and physiological differences between adult and pediatric patients • Pediatric medical and trauma emergencies 	
9. Ambulance Prehospital Care Operations	<ul style="list-style-type: none"> • Medical devices • Rescue and extrication • Contingency hazards • Personal protection equipment • Accidental exposure 	
10. OC Operations	<ul style="list-style-type: none"> • OC software • Telephone management and working systems • Ambulance GPS tracking system • Triage and emergency dispatch procedures and protocols 	OC Operators
11. Fleet Management	<ul style="list-style-type: none"> • Tracking system • Communication system • Vehicle maintenance and cleaning • Supply chain logistics • Incident reporting 	Paramedics, Ambulance Drivers

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Table 1. NEMS Basic Course Curriculum

Abbreviations: BLS, Basic Life Support; GPS, global positioning system; NEMS, National Emergency Medical Services; OC, operation center.

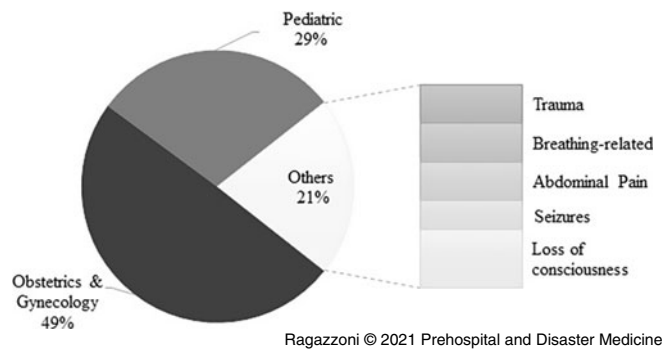


Figure 3. NEMS Missions' Complaints.
Abbreviation: NEMS, National Emergency Medical Services.

conceived the presented idea, participated in the implementation phase of the project, supervised data acquisition, drafted the article, designed figures and tables, and provided final approval of the version to be submitted. Paolo Rosi, Riccardo Buson, Federico Merlo, Francesco Della Corte, Matthew Jusu Vandy, and Amara Jambai participated in the implementation phase of the project, critically revised the manuscript, and provided final approval of the version to be submitted. Sara Pini participated in the implementation phase of the project, supervised data acquisition, critically revised the manuscript, and provided final approval of the version to be submitted. Giovanni Putoto participated in the initial design and supervised the implementation phase of the project, critically revised the manuscript, and provided final approval of the version to be submitted.

References

- World Health Organization. Sierra Leone Country Information. <https://www.afro.who.int/countries/sierra-leone>. Accessed June 23, 2020.
- United Nations Development Programme. Human Development Indicators. <http://hdr.undp.org/en/countries/profiles/SLE#>. Accessed June 23, 2020.
- Government of Sierra Leone, Ministry of Health and Sanitation. Annual Health Sector Performance Report 2016. <https://www.afro.who.int/publications/sierra-leone-health-sector-performance-report-2016>. Accessed June 23, 2020.
- Bolkán HA, Hagander L, von Schreeb J, et al. The surgical workforce and surgical provider productivity in Sierra Leone: a countrywide inventory. *World J Surg.* 2016;40(6):1344–1351.
- Gupta S, Groen RS, Kyamanywa P, et al. Surgical care needs of low-resource populations: an estimate of the prevalence of surgically treatable conditions and avoidable deaths in 48 countries. *Lancet.* 2015;385(Suppl 2):S1.
- Government of Sierra Leone, Ministry of Health and Sanitation. Service Availability and Readiness Assessment (SARA) Plus report 2017. <https://www.opendatas.gov.sl/dataset/sierra-leone-sara-plus-report-2017>. Accessed June 23, 2020.
- Mould-Millman NK, Dixon JM, Sefa N, et al. The state of Emergency Medical Services (EMS) systems in Africa. *Prehosp Disaster Med.* 2017;32(3):273–283.
- World Bank. <http://data.worldbank.org/country/sierra-leone>. Accessed June 23, 2020.
- Government of Sierra Leone. National Ebola Recovery Strategy for Sierra Leone 2015–2017. https://ebolaresponse.un.org/sites/default/files/sierra_leone_recovery_strategy_en.pdf. Accessed June 23, 2020.
- World Health Organization. WHO emergency care system framework infographic. http://www.who.int/emergencycare/emergencycare_infographic/en/. Accessed June 23, 2020.
- Ong ME, Cho J, Ma MH, et al. Comparison of emergency medical services systems in the pan-Asian resuscitation outcomes study countries: report from a literature review and survey. *Emerg Med Australas.* 2013;25(1):55–63.
- Henry JA, Reingold AL. Prehospital trauma systems reduce mortality in developing countries: a systematic review and meta-analysis. *J Trauma Acute Care Surg.* 2012;73(1):261–268.
- Suryanto, Plummer V, Boyle M. EMS systems in lower-middle income countries: a literature review. *Prehosp Disaster Med.* 2017;32(1):64–70.
- Mould-Millman NK, Oteng R, Zakariah A, et al. Assessment of Emergency Medical Services in the Ashanti Region of Ghana. *Ghana Med J.* 2015;49(3):125–135.
- Mould-Millman NK, Rominski SD, Bogus J, et al. Barriers to accessing Emergency Medical Services in Accra, Ghana: development of a survey instrument and initial application in Ghana. *Glob Health Sci Pract.* 2015;3(4):577–590.
- Adamtey R, Frimpong J, Dinye RD. An analysis of emergency healthcare delivery in Ghana: lessons from ambulance and emergency services in Bibiani Anhwiaso Bekwai District. *Ghana Journal of Development Studies.* 2015;12(1-2):71.
- Tansley G, Stewart B, Zakariah A, et al. Population-level spatial access to prehospital care by the National Ambulance Service in Ghana. *Prehosp Emerg Care.* 2016;20(6):768–775.
- Nesbitt RC, Gabrysch S, Laub A, et al. Methods to measure potential spatial access to delivery care in low- and middle-income countries: a case study in rural Ghana. *Int J Health Geogr.* 2014;13:25.
- Stewart BT, Tansley G, Gyedu A, et al. Mapping population-level spatial access to essential surgical care in Ghana using availability of bellwether procedures. *JAMA Surg.* 2016;151(8):e161239.
- Kobusingye OC, Hyder AA, Bishai D, Hicks ER, Mock C, Joshipura M. Emergency medical systems in low- and middle-income countries: recommendations for action. *Bull World Health Organ.* 2005;83(8):626–631.
- Nicholson B, McCollough C, Wachira B, Mould-Millman NK. Emergency medical services (EMS) training in Kenya: findings and recommendations from an educational assessment. *Afr J Emerg Med.* 2017;7(4):157–159.
- Obermeyer Z, Abujaber S, Makar M, et al. Emergency care in 59 low- and middle-income countries: a systematic review. *Bull World Health Organ.* 2015;93(8):577–586G.
- Kern DE, Thomas PA, Hughes MT. *Curriculum Development for Medical Education: A Six-Step Approach.* 2nd ed. Baltimore, Maryland USA: Johns Hopkins University Press; 2009.
- Pittalis C, Brugha R, Gajewski J. Surgical referral systems in low- and middle-income countries: a review of the evidence. *PLoS One.* 2019;14(9):e0223328.
- Daniels AA, Abuosi A. Improving emergency obstetric referral systems in low- and middle-income countries: a qualitative study in a tertiary health facility in Ghana. *BMC Health Serv Res.* 2020;20(1):32.
- Nuriddin A, Jalloh MF, Meyer E, et al. Trust, fear, stigma and disruptions: community perceptions and experiences during periods of low but ongoing transmission of Ebola virus disease in Sierra Leone, 2015. *BMJ Glob Health.* 2018;3(2):e000410.