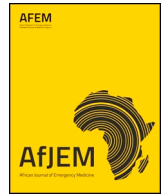




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## REVIEW ARTICLE

## Fifteen years of emergency medicine literature in Africa: A scoping review

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## ABSTRACT

**Introduction:** Emergency medicine (EM) throughout Africa exists in various stages of development. The number and types of scientific EM literature can serve as a proxy indicator of EM regional development and activity. The goal of this scoping review is a preliminary assessment of potential size and scope of available African EM literature published over 15 years.

**Methods:** We searched five indexed international databases as well as non-indexed grey literature from 1999–2014 using key search terms including “Africa”, “emergency medicine”, “emergency medical services”, and “disaster.” Two trained physician reviewers independently assessed whether each article met one or more of five inclusion criteria, and discordant results were adjudicated by a senior reviewer. Articles were categorised by subject and country of origin. Publication number per country was normalised by 1,000,000 population.

**Results:** Of 6091 identified articles, 633 (10.4%) were included. African publications increased 10-fold from 1999 to 2013 (9 to 94 articles, respectively). Western Africa had the highest number (212, 33.5%) per region. South Africa had the largest number of articles per country (171, 27.0%) followed by Nigeria, Kenya, and Ghana. 537 (84.8%) articles pertained to facility-based EM, 188 (29.7%) to out-of-hospital emergency medicine, and 109 (17.2%) to disaster medicine. Predominant content areas were epidemiology (374, 59.1%), EM systems (321, 50.7%) and clinical care (262, 41.4%). The most common study design was observational (479, 75.7%), with only 28 (4.4%) interventional studies. All-comers (382, 59.9%) and children (91, 14.1%) were the most commonly studied patient populations. Undifferentiated (313, 49.4%) and traumatic (180, 28.4%) complaints were most common.

**Conclusion:** Our review revealed a considerable increase in the growth of African EM literature from 1999 to 2014. Overwhelmingly, articles were observational, studied all-comers, and focused on undifferentiated complaints. The articles discovered in this scoping review are reflective of the relatively immature and growing state of African EM.

## African relevance

- This is the first systematic review focused on African Emergency Medicine literature.

- Our review included literature databases unique to the African context.
- Articles are described in the context of African Emergency Medicine development.

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## Introduction

According to the Disease Control Priorities in Developing Countries, the burden of acute medical, surgical, and obstetric conditions disproportionately affects low- and middle-income countries (LMICs) in Africa [1]. Of the approximately 45 million deaths in LMICs each year, an estimated 54% of mortality could be addressed with the development of emergency care systems in such LMICs [1]. To date, development of such systems in Africa has varied from non-existent to advanced, but the exact degree of development has been difficult to quantify in most nations [2].

Emergency medicine (EM) spans a continuum of care. Prehospital and in-hospital components are both necessary to identify, respond, resuscitate, and transport patients with life- or limb-threatening conditions to definitive care [3]. Unlike many vertical programs that target a specific disease or outcome, EM is horizontally integrated to address all time-sensitive conditions that may rapidly progress to death or disability if left untreated, thereby strengthening the system universally [4,5].

In the absence of adequate data on national and regional development of African EM systems, the number of publications originating in Africa serves as one indicator of development [6]. Previous literature reviews, such as the annual Global Emergency Medicine Literature Review (GEMLR), have succeeded in describing trends from publications in LMICs and identifying top articles. However, prior reviews have not specifically quantified and described national and regional publication numbers and content over time in Africa [7,8].

The purpose of this investigation is to assess and describe the scope of scientific literature published on EM in Africa, to help identify both advances and gaps in EM activity, including research and development. The specific objective of this study is to use a scoping review (i.e. a preliminary assessment of potential size and scope of available research literature) to help characterise scientific African EM published literature over 15 years. These findings may serve as a potential marker EM development trends on the African continent.

## Methods

The study design is a scoping review of indexed databases and grey literature related to EM in Africa, which includes prehospital emergency care. The period of interest included articles published from January 1, 1999 to December 31, 2014. Searches were conducted initially in April 2014 and again in June 2015, to increase inclusion of all articles published in late 2014. Specific search dates can be found in Appendix B.

The scoping review group was composed of 11 academic EM physicians – five reviewers (*redacted*) had primary affiliations with African institutions, and six reviewers (*redacted*) had American institutional affiliations. Each reviewer was trained by the principal investigator (*redacted*) on inclusion and exclusion criteria, the review and categorisation process, and storage of data related to each search. Practice reviews were performed with direct feedback from the principal investigator.

We developed a keyword search strategy including the following terms: emergency medicine, emergency medical services, EMS, emergency care, prehospital, ambulance, helicopter, emergency medical technician, paramedic, emergency responders, emergency mobile unit, disaster, and Africa. Additionally, each African country name and five African regions (North, South, East, West, and Central) were also used as search terms. A detailed list of search terms, including Medical Subject Headings (MESH) terms for MEDLINE®, can be found in Appendix B.

To discover relevant peer-reviewed literature, we searched the following indexed databases: MEDLINE®, Excerpta Medica Database (EMBASE), World Health Organization (WHO) Index Medicus, African Journals Online (AJOL), and the Cochrane Database of Systematic Reviews (CDSR). To discover relevant grey (non-indexed) literature, four reviewers (*redacted*) independently performed an online search of the World Wide Web, using two strategies. First, publications were identified from Google and Google Scholar search engines, using the same keywords as the indexed databases. Second, there were targeted searches for relevant literature within websites of specific global health organisations, institutions, and agencies with relevance to emergency care, emergency medicine, and/or emergency medical services. The organisations, institutions, and agencies are listed in Table 1.

Last, the African Journal of Emergency Medicine (AfJEM) was hand searched for articles satisfying inclusion criteria, given the specific focus of the journal to Africa and EM. There was no language limitation placed on searches.

Each article abstract identified from the searches was independently assessed by two initial reviewers to determine whether the article satisfied one or more of five inclusion criteria: 1) Is the article about emergency care or emergency medicine? 2) Is the article about EMS or prehospital emergency care? 3) Is the article about emergency transportation or ambulances? 4) Is the article about emergency obstetric care, and if so, is there direct overlap with #1, #2 or #3 above? 5) Is the article about trauma or trauma care, and if so, is there direct overlap with #1, #2 or #3 above? Criteria #4 and #5 were important to eliminate a preponderance of obstetric or injury-related publications that did not have direct relevance to EM. The following article types

**Table 1**  
Organisations, Institutions, and Agencies reviewed to discover African EM grey literature.

NGOs, UN, and government agency websites	Think Tanks:
1. MEASURE Evaluation	1. Global Health Council
2. Médecins Sans Frontières	2. Centre for Global Development
3. Epicentre	3. The United Nations University
4. International Rescue Committee	4. RAND Corporation
5. International Medical Corps	5. The Woodrow Wilson Center
6. Oxfam International	6. The Bill and Melinda Gates Foundation
7. German Corporation for Technical Cooperation	7. Center for Global Health Research, University of Toronto
8. Oxfam Great Britain	8. Emergency Trauma Care Project
9. International Committee of the Red Cross	
10. Centers for Disease Control and Prevention	
11. World Health Organization	
12. Humanitarian Practice Network	
13. United Nations High Commission for Refugees	
14. United Nations Development Program	
15. Inter-Agency Standing Committee	
16. United Nations International Children's Educational Fund	
17. Johns Hopkins Program for International Education in Gynecology and Obstetrics	
18. World Bank	

were excluded: opinion pieces, editorials, letters, and abstracts presented solely at a conference or similar forum.

Discordant reviews between primary reviewers were resolved by the senior reviewer. Additionally, 10% of articles selected for inclusion by both reviewers were re-reviewed by the senior reviewer as a quality assurance measure. Duplicate articles were removed.

For each included article abstract, the following were recorded by the reviewers after inclusion criteria were met: publication year, country, region, publication language and first author country. Each article abstract was further described, by the reviewers in each of five areas; discipline (i.e. EM, EMS, or disaster medicine), content area (i.e. clinical care, or epidemiology), study design (i.e. observational or interventional), study population (e.g. adults, paediatrics, obstetric), and condition (e.g. medical, trauma). Articles pertaining to more than one African country were categorised such that each named country within the article received credit. Descriptive characteristics were recorded stored in Microsoft Excel (Redmond, WA) and any disagreements resolved by the senior reviewer.

Basic descriptive statistics, including proportion of inter-rater agreement, were performed. To adjust for differences in country population size, publication number per country was normalised by 1,000,000 population [9]. Data were stored in Microsoft Excel (Redmond, WA).

### Results

A total of 6091 article abstracts were identified for detailed review (Fig. 1). After removal of articles duplicated or repeated in journal databases, 4681 were reviewed and 633 articles met inclusion criteria (Appendix C). The overall inter-rater agreement was 83%.

**Table 2**  
Distribution of articles among African regions<sup>a</sup> and languages.

African Region	Number (%)
Western	212 (33.5)
Southern	206 (32.5)
Eastern	105 (16.6)
Northern	45 (7.1)
All	43 (6.8)
Central	11 (1.7)
Language	Number (%)
English	585 (92.4)
French	45 (7.1)
Danish	1 (0.2)
German	1 (0.2)
Afrikaans	1 (0.2)

<sup>a</sup> Regions defined by United Nations Economic Commission for Africa.

The following databases produced the highest yield of included articles: MEDLINE (53.3%), AJOL (22.4%), and AfJEM (11.6%) with 404 (63.8%) identified through indexed databases (Fig. 1).

Included articles represent EM publications from all five African Regions (Table 2) and from 44 African countries (Fig. 2). Publications were in five different languages with the majority (585, 92.4%) in English. The overall 15-year trend showed a steady increase in articles, and a nearly ten-fold increase in articles published in 1999 and 2000 compared to 2013 and 2014 (Fig. 3).

Articles related to EM in South Africa (171, 27.0%) and Nigeria (163, 25.7%) comprised over half the included articles, followed by articles generalisable to all African countries (43, 6.8%), Kenya (31,

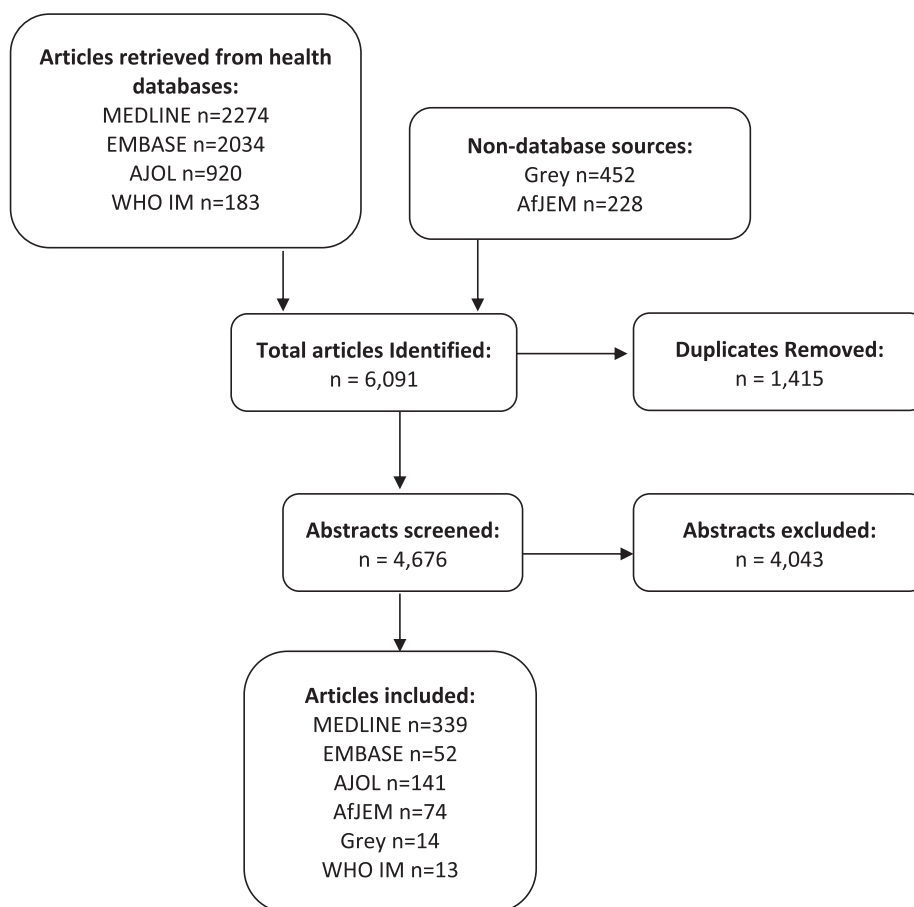


Fig. 1. Article inclusion flow diagram.

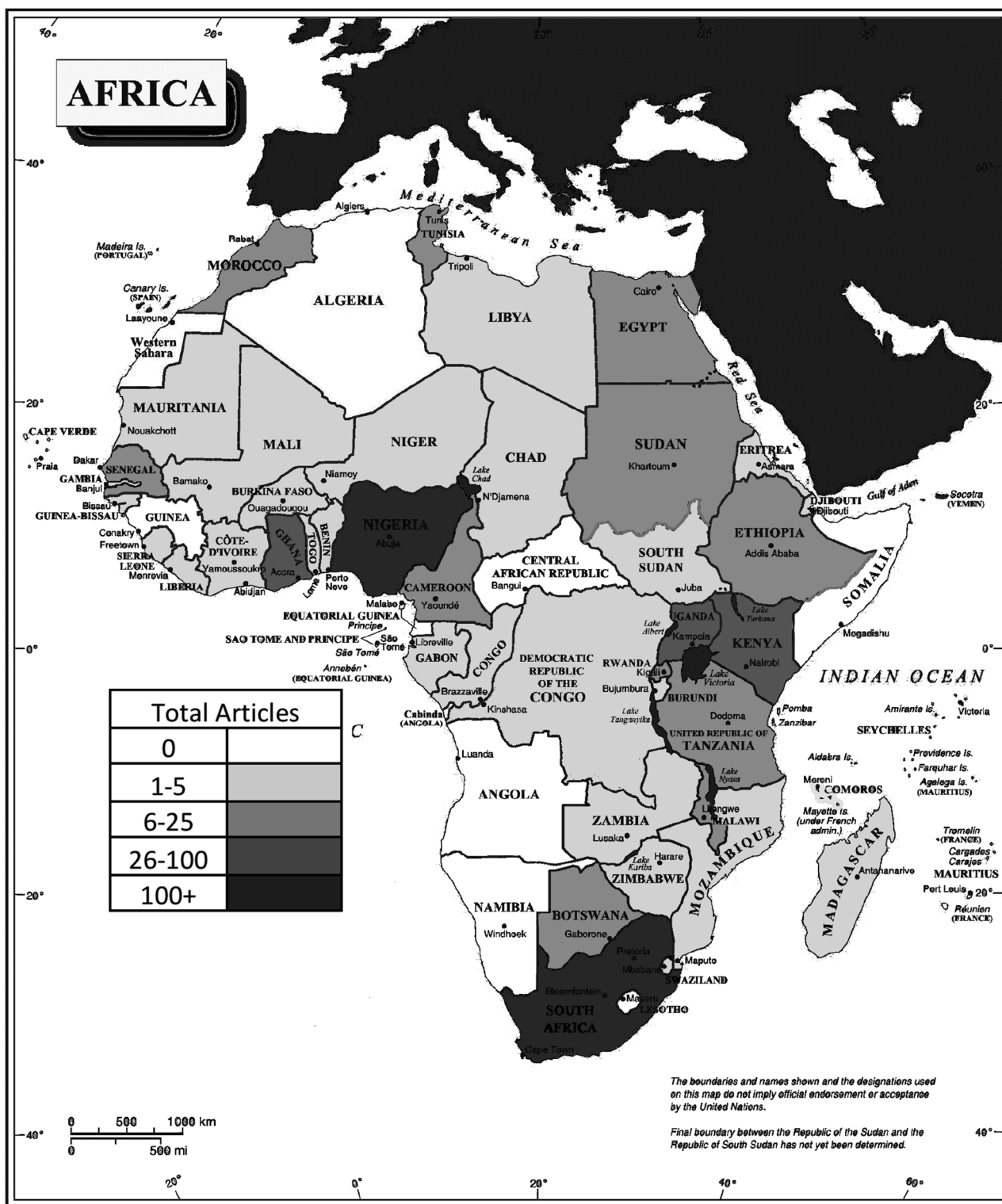


Fig. 2. Number of articles by country.

4.9%), Ghana (27, 4.3%) and Uganda (26, 4.1%). (Table 3) Twenty-eight countries (63.6%) had five or fewer total publications. Of countries with more than 10 articles, South Africa had the highest number of articles normalised per million population [9] (Table 3).

Most (over 75%) of included articles were observational, and described demographics and presenting clinical conditions (Table 4). Few (28, 4.4%) were interventional studies of which 6 (0.9%) were randomised control trials. South Africa and Malawi had the largest number of

interventional articles with six (0.9%) each. The relative percentage of interventional studies plateaued from 2006 to 2012, and trended downwards during the last 3 years of the review. (Fig. 4) South Africa had the largest number of descriptive (17, 2.7%) and clinical reviews (16, 2.5%) while Nigeria had the largest number of observational studies (157, 24.8%). The mean annual proportion of all articles that were review articles increased in their relative proportion, from 4.1% before 2010, to 10.7% of all articles from 2010 onwards.

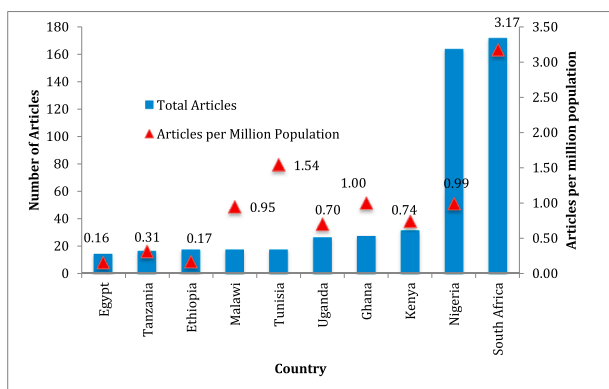


Fig. 3. Ten countries with the largest number of articles.

**Table 3**  
Characteristics of Articles from Countries with more than 10 Articles published between 1999 and 2014.

Country (Total number of articles)	Number of Articles/1,000,000 population	Number of Clinical Care Articles (%)
South Africa (171)	3.17	78 (45.3)
Nigeria (163)	0.99	40 (24.5)
Kenya (31)	0.74	8 (25.8)
Ghana (27)	1.00	6 (19.4)
Uganda (26)	0.70	11 (42.3)
Ethiopia (17)	0.17	3 (17.6)
Tunisia (17)	1.54	8 (47.1)
Malawi (17)	0.95	8 (47.1)
Tanzania (16)	0.31	3 (18.8)
Egypt (14)	0.16	5 (35.7)
Morocco (13)	0.39	6 (54.5)
Rwanda (11)	0.85	3 (27.3)
Sudan (11)	0.30	4 (36.3)

The majority of articles related to in-hospital EM (537, 84.8%) and discussed the epidemiology of a particular disease process (374, 59.1%), see Table 4. Less than 30% of articles discussed prehospital medicine or transport issues. Nigeria had the largest number of EM epidemiological articles (130, 20.5%), and South Africa had the largest number of publications focusing on EM systems (95, 15.0%) and clinical care (78, 12.3%).

The most frequently studied population was undifferentiated patients (382, 59.9%), followed by paediatrics (90, 14.1%). In a small proportion of articles, emergency medicine providers (69, 10.8%) and lay providers (7, 1.1%) were the study subjects. Most studies did not differentiate between specific conditions (313, 49.4), but traumatic injury was the most common specific condition studied (180, 28.4).

Emergency care and epidemiology made up the majority of the disciplines covered in observational studies. In contrast, interventional articles dealt with a larger percentage of EMS discipline but no disaster/humanitarian. Content areas of education and clinical care with more represented by interventional than observational articles (Fig. 5).

Overall, 436 articles (68.9) had an African first author with Tunisia and Morocco having the highest percentage of articles with African first authors (Table 5).

**Discussion**

To the best of our knowledge, this study represents the first scoping review dedicated to EM literature in Africa. Overall, we found a steadily increasing number of published articles, which reflects the growing field of EM. We offer interpretations and explain the significance of our findings to purposefully inform the ongoing development priorities of EM in Africa.

Observational studies constitute the overwhelming majority (over

**Table 4**  
Content areas covered by articles.

Content Areas	Number (%) <sup>b</sup>
<i>Study Design</i>	
Observational	479 (75.7)
Descriptive	61 (9.6)
Clinical Review	49 (7.7)
Interventional	28 (4.4)
Report	15 (2.4)
<i>Discipline</i>	
Emergency Medicine	537 (84.8)
Prehospital or Transport	188 (29.7)
Disaster/Humanitarian Relief	109 (17.2)
<i>Content Area</i>	
Epidemiology	374 (59.1)
Systems	321 (50.7)
Clinical Care	262 (41.3)
Education	117 (18.5)
<i>Study Population</i>	
Undifferentiated	378 (59.2)
Paediatrics	90 (14.1)
Emergency Providers	69 (10.8)
Adults	61 (9.6)
Obstetric	21 (3.3)
Lay Providers	8 (1.1)
Military	1 (0.2)
<i>Condition</i>	
Undifferentiated	313 (49.4)
Trauma	180 (28.4)
Medical	101 (16.0)
Obstetric	22 (3.5)
Surgical	17 (2.7)

<sup>b</sup> Percentages in each category do not total 100%, as each article could have multiple focus areas.

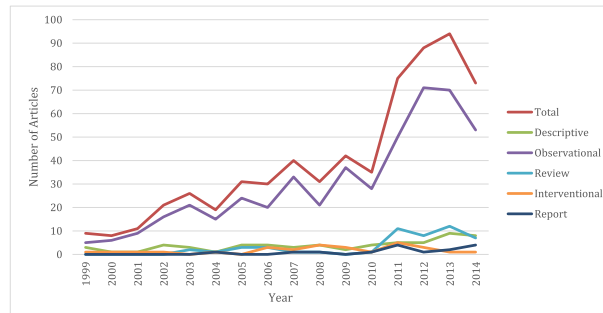


Fig. 4. 15-Year trend in type of African publications.

75%) of all published EM research in Africa (Table 4). There may be several reasons for this. First, most African countries lack specialty emergency care and characterising the burden of disease and the state of EM systems is therefore necessary for evidence-based advocacy for EM development. Second, observational studies may be a natural starting point for African EM experts and foreign collaborators to establish a baseline for future interventions, including defining the burden of disease. “A Two-Year Review of Medical Admissions at the Emergency Unit of a Nigerian Tertiary Health Facility” [19] and “Analysis of traumatic injuries presenting to a referral hospital emergency department in Moshi, Tanzania” [20] are representative articles within this category that define the epidemiology and conditions in African emergency centres. The majority of these descriptive studies did not provide details regarding the clinical care provided or patient outcomes. Finally, observational studies are less technically challenging, less complex, and less expensive to conduct compared to interventional studies. Given the paucity of African EM researchers and a lack of funding streams for such research, this predominance of observational studies is expected.



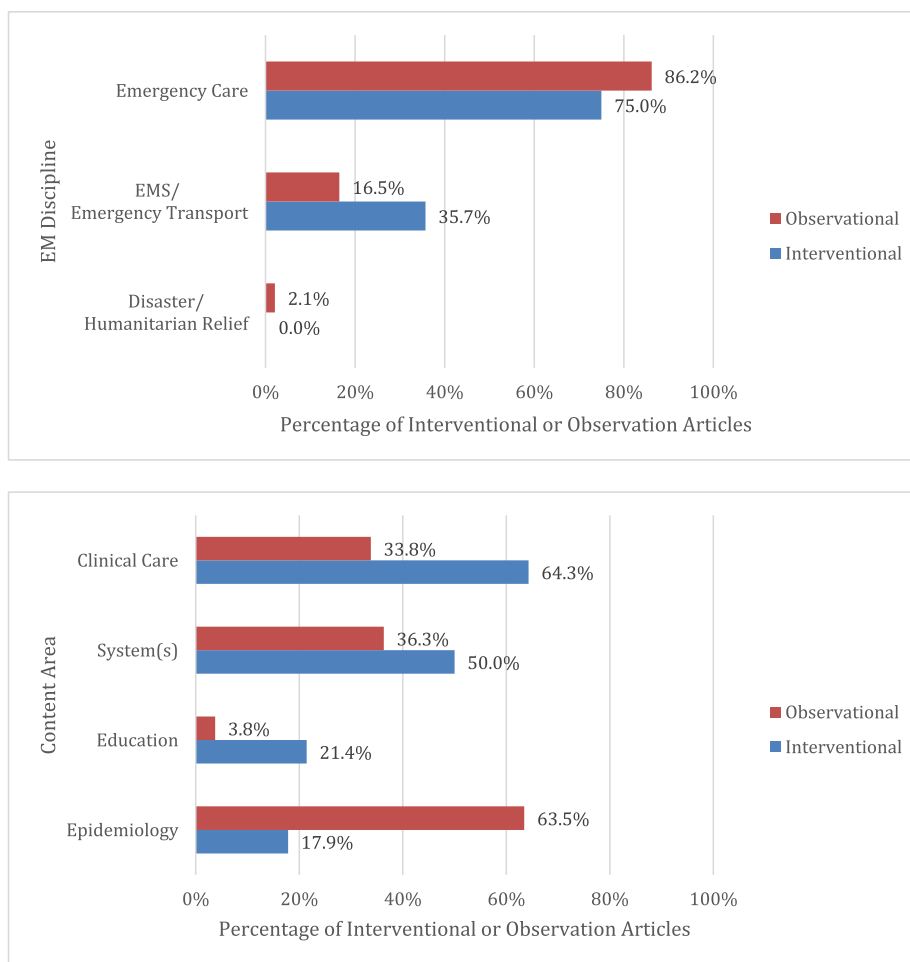


Fig. 5. Breakdown of discipline and content areas in observational versus i.

Table 5  
First Authorship and Indexed Article status by African Country.

Country	Professional Society	EM Residency <sup>13-20</sup>	Number of African First Author, (%)	Number of Indexed Articles, (%)
South Africa	Yes	Yes	151 (88.3)	127 (74.3)
Nigeria	Yes	No	121 (75.2)	82 (50.3)
Kenya	No	No	22 (71.0)	14 (45.2)
Ghana	No	Yes	9 (29.0)	17 (63.0)
Uganda	No	No	15 (57.7)	20 (77.0)
Ethiopia	Yes	Yes	10 (58.8)	12 (70.6)
Tunisia	No	No	17 (100)	17 (100)
Malawi	No	No	7 (41.1)	15 (88.2)
Tanzania	Yes	Yes	4 (25.0)	10 (62.5)
Egypt	Yes	Yes	10 (71.4)	11 (78.6)
Morocco	No	No	10 (90.9)	11 (86.4)
Rwanda	Yes	Yes	5 (45.5)	5 (45.5)
Sudan	Yes	Yes	7 (63.6)	6 (54.5)

NB: “EM” = Emergency Medicine.

In comparison, conducting an interventional study requires multiple levels of development including appropriate infrastructure and research-trained specialists. Medical training in much of Africa has not traditionally included research methodology or academic writing, and this issue is compounded by the paucity of ethical review boards and limited support for grant and technical writing in Africa [23–27]. The US National Institutes of Health (NIH) Medical Educational Partnership Initiative (MEPI) was specifically designed to support specialist medical training with a large focus on research training [22]. Findings from this

study suggest the need for further training of African EM physicians in the technical and administrative aspects of biomedical research.

Impressively, we noted a nearly a ten-fold increase in articles published per year, when comparing early to latter years in our study period (Fig. 3). We theorise that this dramatic increase in annual EM article publication reflects the rapid growth in EM training and practice in many African countries, especially over the past decade [2–5]. For example, in the past 10-years, professional emergency medicine societies were formed in eight African countries [13–20] (personal communication: Hendry Sawe, African Federation for Emergency Medicine). These countries constitute eight of our reported top 10 countries with the highest absolute and population adjusted publication volume. However, two of top five countries, Uganda and Kenya had neither a professional society nor a residency program, during the review period. Additionally, it is worth noting that out of nine African countries with established EM residency training programs in 2015 (Botswana, Ethiopia, Ghana, Rwanda, South Africa, Sudan, Tanzania), seven are represented in our top 10 list [23–27].

Regarding the published content areas, descriptions of local epidemiology and systems of care are predominant (Table 4). This may reflect the state of clinical data captured via routine documentation; specifically, prior studies have reflected the ready availability of demographics and chief complaint data, but records of clinical care and outcomes are more difficult to gather retrospectively [2]. Less than 50% of articles included information about clinical care (Table 4).

Although nearly half of all studies included undifferentiated conditions (all-comers), articles focusing on traumatic injuries made up a quarter of the studies (Table 4). For the past two decades, injury has

served as an exemplary condition that bolsters the argument for development of African EM systems. Globally, mortality from injuries has surpassed those from malaria, tuberculosis, and HIV combined, and Africa leads the global morbidity and mortality rates from injuries [28,29]. Consequently, the public health relevance of traumatic conditions is well reflected in the existing African EM literature.

When examining publication volume from specific countries, an interesting association between country-specific publication volume and economic development arises. Our study showed that South Africa and Nigeria have the highest absolute number of publications in the 15-year study period (Table 5). South Africa is an upper-middle income country, the fifth most populous in Africa, and has Africa's oldest formal EM residency training program, as well as matured EM and EMS professional societies. Nigeria is a lower-middle income and the most populous African country, without formalised EM professional societies or training programs [9]. Interestingly, South Africa's higher level of development correlates with a larger proportion of interventional studies and publications related to clinical care. Nigeria, in contrast, produced mostly observational studies.

Another indicator of development is authorship; there was a heterogeneous proportion of publications with African first authors by country, ranging from 25% in Tanzania to 100% in Tunisia and Morocco. The Tanzanian Emergency Medicine Residency training program and EM professional society, for example, has consistently collaborated with high-income country universities, e.g. the University of California, San Francisco [21]. One benefit of such international collaboration to African researchers is the ability to leverage research infrastructure and resources of the high-income country universities. As the specialty of EM continues to grow across Africa, it will be critical to African programs to locally prioritise and support research training amongst graduates of African residencies.

It is worth acknowledging that interpretation of these data, specifically the exponential increase in publications, must be taken in larger context of major global health funding that has occurred over the time period of our survey. The ascendancy of the Gates Foundation, the United States President's Emergency Plan for AIDS Relief (PEPFAR), and the Global Alliance for Vaccinations and Immunizations (GAVI), for example, have drastically changed the global health resource landscape in Africa over the 15-year review period – these funding programs, amongst numerous others, may have an indirect and immeasurable influence on our findings. Africa has also experienced a surge in university-based global health programs from North America, Europe, and Australia that collaborate with African counterparts, providing further capacity for published articles [12]. Understanding these and many other global trends, we have not endeavoured to attribute our survey of EM literature origination to funding sources, but rather merely to inventory the body of literature itself, in part as a proxy for EM-related practice.

An inherent, but accepted, weakness in scoping reviews is the limitation of the search strategy that may under-extract articles from the queried databases or sources. A concerted effort was made to include a large variety of peer-reviewed sources as well as grey literature, and expansive search terms, to maximise our article yield. Databases were re-queried in mid 2015, however due to delays in indexing publications, some studies in late 2014 may not have been available at the time our search was performed. Second, although our inter-rater agreement was high, inclusion criteria #4 and #5 were somewhat subjective, thereby causing occasionally discordant findings between reviewer pairs – the effect of this was mitigated by a senior investigator third review. Third, due to the lack of standardised metrics for EM system development, we were unable to scientifically test the hypothesis that publication number correlates with EM development. Fourth, articles from North African countries were under-represented in our sample – these articles may have been published in Middle Eastern journals or in databases outside those we searched. Although there was no language limitation, we searched databases that primarily index English articles. Finally, we

are unable to comment extensively on the content within the articles, as a thorough content review was not the primary intent of this study.

## Conclusions

Our scoping review revealed a near ten-fold growth over 15 years in the EM literature across Africa, most notably in Southern and Western Africa. Most articles were observational in design and described large caseloads of undifferentiated patients. This review advances our understanding of the expanding African health care landscape, may provide evidence to support advocacy for African emergency care development, and may serve to benchmark growth and maturation in the field of emergency medicine across Africa.

Given the general paucity of existing primary data regarding the development of EM in Africa, and the relative online availability of published EM materials, it is an innovative approach to examine the breadth and depth of EM literature to provide an indirect, but useful, measure of EM-related activity and development in Africa. We hypothesise that the type and volume of published EM literature serves as one proxy indicator for the state of EM development, by African country and by African region. Further research is needed to validate this hypothesis.

As advocacy for EM across Africa improves, in part through international organisations like the World Health Organization and the African Federation for Emergency Medicine (via a mentored author assist program), we hope there will be increased funding for African EM development, including infrastructure and training for EM research, which may ultimately translate into more rigorous investigational and interventional research.

## Author contribution

Authors contributed as follow to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; drafting the work or revising it critically for important intellectual content; and final approval of the version to be published: NM and JD 22% each; TWB 15%; NS, HP, AQY, AO, TO, IB, MO, HS 4% each; and JL, TC and LAW 3% each. All authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

## Conflicts of interest

Drs Maxwell Osei-Ampofo, Hendry Sawe and Prof Lee Wallis are editors of the African Journal of Emergency Medicine. They were not involved in the editorial workflow for this manuscript. The African Journal of Emergency Medicine applies a double blinded process for all manuscript peer reviews. The authors declared no further conflict of interest.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.afjem.2019.01.006>.

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