




# BMJ Open Out-of-hospital cardiac arrest in Africa: a scoping review

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## ABSTRACT

**Introduction** Out-of-hospital cardiac arrest (OHCA) is well studied in high-income countries, and research has encouraged the implementation of policy to increase survival rates. On the other hand, comprehensive research on OHCA in Africa is sparse, despite the higher incidence of risk factors. In this vein, structural barriers to OHCA care in Africa must be fully recognised and understood before similar improvements in outcome may be made. The aim of this study was to describe and summarise the body of literature related to OHCA in Africa.

**Methods and analysis** Using an a priori developed search strategy, electronic searches were performed in Medline via Pubmed, Web of Science, Scopus and Google Scholar databases to identify articles published in English between 2000 and 2020 relevant to OHCA in Africa. Titles, abstract and full text were reviewed by two reviewers, with discrepancies handled by an independent reviewer. A summary of the main themes contained in the literature was developed using descriptive analysis on eligible articles.

**Results** A total of 1200 articles were identified. In the screening process, 785 articles were excluded based on title, and a further 127 were excluded following abstract review. During full-text review to determine eligibility, 80 articles were excluded and one was added following references review. A total of 19 articles met the inclusion criteria. During analysis, the following three themes were found: epidemiology and underlying causes for OHCA, first aid training and bystander action, and Emergency Medical Services (EMS) resuscitation and training.

**Conclusions** In order to begin addressing OHCA in Africa, representative research with standardised reporting that complies to data standards is required to understand the full, context-specific picture. Policies and research may then target underlying conditions, improvements in bystander and EMS training, and system improvements that are contextually relevant and ultimately result in better outcomes for OHCA victims.

## INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) is the cessation of cardiac activity that occurs outside of the hospital setting.<sup>1</sup> Although interventions such as bystander cardiopulmonary resuscitation (CPR) and early defibrillation can greatly improve a patient's chance of survival, many of those who experience OHCA do not receive these early interventions.<sup>2</sup> Low survival rates are worsened when the arrival of Emergency Medical Services (EMS) and their provision

## Strengths and limitations of this study

- A scoping review provides the backbone for context-specific research on out-of-hospital cardiac arrest (OHCA) in Africa that can then target interventions which strengthen the entire chain of survival.
- A scoping review providing an overview of the incidence of OHCA in Africa and the factors that contribute to poor outcomes advances the research agenda to provide rigorous epidemiological reporting on OHCA in Africa, evaluate cost-effectiveness of policies to address OHCA and improve Emergency Medical Services and bystander training.
- Limitations lie in the inclusion criteria and the databases interrogated: some papers and grey literature may not have been included, papers in languages other than English may have been missed and non-academic literature such as policy reports was also not included.

of CPR and additional care is delayed.<sup>3</sup> These factors are interrelated as part of the *chain of survival*, comprised of recognition and activation of EMS, early CPR, rapid defibrillation, basic and ALS and postcardiac arrest care.<sup>4</sup> Due to the interconnected nature of these factors, the chain is described as being only as strong as its weakest link, making each link important in OHCA care.<sup>5</sup>

While there is a great deal of information on OHCA in countries from high-income country (HIC) settings, limited information is available regarding Africa, and more broadly low-income and middle-income countries (LMICs). The time sensitive nature of OHCA is well established, and the importance of all links of the chain of survival are well documented.<sup>6 7</sup> As such, HIC settings focus on targeted interventions at each of these stages of care, resulting in significant enhancements in OHCA survival rates.<sup>8–10</sup>

Due to numerous structural factors, such as the absence of formal out-of-hospital emergency care services, longer response times and infrequent bystander intervention, LMICs experience higher mortality rates compared with countries with fewer barriers to care.<sup>11</sup> Moreover, African countries are experiencing



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an increasing incidence of risk factors for OHCA, such as cardiovascular disease (CVD), which makes OHCA care in Africa a particularly important area of study.<sup>12</sup> The Global Burden of Disease Project predicted that by the end of 2020, the CVD burden faced by African countries would have doubled since 1990, yet specific comprehensive data regarding the disease burden in Africa are not readily available.<sup>13</sup>

In order to develop policies to improve OHCA outcomes in Africa and encourage public engagement with the system, the full picture of OHCA in the African setting must first be understood, including factors such as population characteristics and bystander action. To this end, this scoping review describes and summarises the body of literature related to OHCA in Africa, provides an overview of the literature available and points to areas of future research necessary to inform improvements in OHCA care and outcomes.

## METHODOLOGY

### Study design

A scoping review was performed to identify articles relevant to OHCA in Africa. Medline via Pubmed, Web of Science, Scopus and Google Scholar databases were interrogated. The results are contained in online supplemental material 1, while the unpublished search strategy is contained in online supplemental material 2, where relevant keywords were combined with Boolean operators.

Articles were limited to those published in English, between 1 June 2000 and 31 June 2020 that describe or involve OHCA in Africa. Articles published on topics unrelated to OHCA, outside of an African setting or the given timeframes or with abstracts in languages other than English were excluded. Articles where a full text was not available or obtainable were also excluded.

Duplicates were eliminated using the relevant function of Microsoft Excel (Microsoft Corporation, Redmond, Washington, USA). Two reviewers independently assessed articles for eligibility by first reviewing the title, then abstract and finally conducting full-text reviews (JT and WS). Discrepancies were resolved by an independent reviewer (KW). Mendeley Software (Elsevier Publishing Company, London, UK) was used to help screen for inclusion or exclusion among reviewers after in depth full-text review.

### Data extraction and analysis

Extracted information from the included full-text articles were compiled into an Excel spreadsheet using a data extraction matrix (online supplemental material 3). The extraction matrix included key findings related to OHCA: activation of emergency services, CPR quality and duration, bystander action, defibrillation timing, timing of EMS, advanced life support (ALS) and postarrest care, pre-existing conditions, survival rates and morbidity. If the affiliations listed were within Africa, the author was considered as an African author.

Formal risk of bias assessment was not conducted, as is practice with scoping review methodology.<sup>14 15</sup> Results are reported following Preferred Reporting Items for Systematic reviews and Meta-Analyses Extension for Scoping Reviews guidelines.<sup>14</sup>

Following data extraction, a summary of the main themes contained in the literature was developed using descriptive analysis on selected articles.

### Patient and public involvement

Patients or the public were not involved in the design, conduct, reporting, or dissemination plans of this study.

## RESULTS

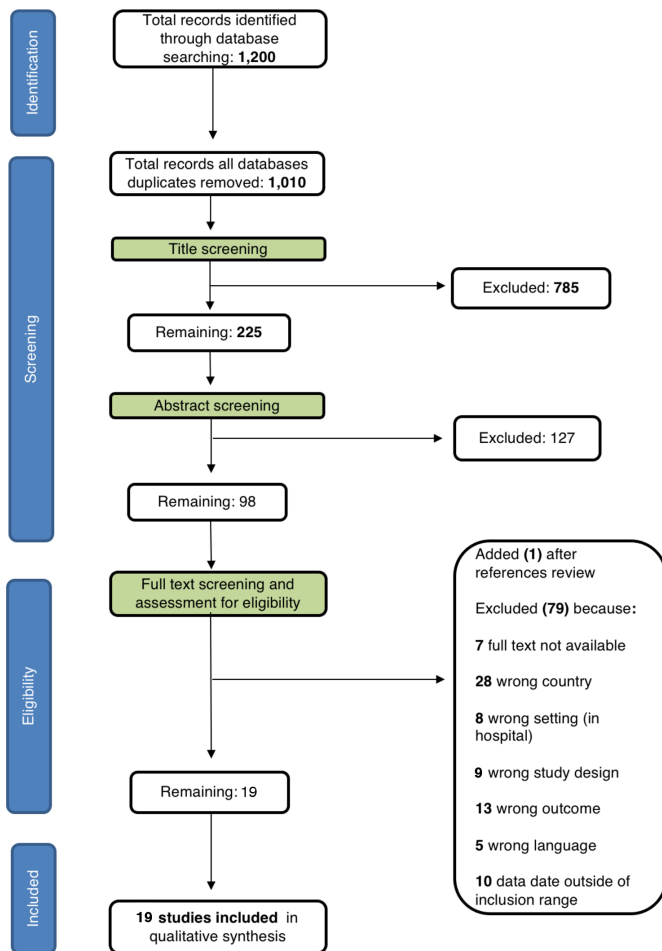
A total of 1200 articles were identified through the database search. In the screening process, 785 articles were excluded based on title, and another 127 articles were excluded following abstract review. During full-text screening to determine eligibility, seven papers were excluded based on the absence of an available full text, 28 papers were from a non-African setting, eight papers were from the hospital setting, nine papers used the wrong study design (not original research), 13 had irrelevant studied outcomes not pertaining to OHCA, five papers were only available in a non-English language and 10 were published outside of the inclusion range. One paper was added after reviewing the references of all included studies. A total of 19 studies were included for analysis (figure 1).

Of the 19 studies included, almost all studies (17/19) were retrospective or qualitative in nature. Of those that were prospective, all (2/19) were observational and no interventional or randomised controlled trials were found. Thus, conclusions of these studies should be interpreted with caution owing to potential bias given the study designs.

The main themes that emerged in the literature were as follows: epidemiology and underlying causes for OHCA, first aid training and bystander action and EMS resuscitation and EMS training (online supplemental material 1). A total of 48% (9/19) of papers failed to report any of the five Utstein variables; 5% (1/19) reported only one of the variables, 26% (5/19) reported two, 16% (3/19) reported three, 5% (1/19) reported four and none (0/19) reported all five of the variables. A total of 32% (6/19) of studies lacked an African primary author, in 32% (6/19) of studies fewer than half of the authorship team represented African authors and 5% (1/19) of studies failed to include a single African author.

### Epidemiology and underlying causes for OHCA

Nine papers reported on epidemiology and underlying causes for OHCA.<sup>16-24</sup> Studies based in Cameroon, Nigeria, Togo, Seychelles, Libya and South Africa found similar results with regard to underlying causes for OHCA. The largest proportion of these studies were based in Nigeria (44%), which is classified as a lower middle-income country by the



**Figure 1** PRISMA diagram of included articles, including identification, screening, eligibility and included stages. PRISMA, Preferred Reporting Items for Systematic reviews and Meta-Analyses.

World Bank. Underlying causes for OHCA were found to be CVDs, including coronary artery disease, hypertensive heart disease, ischaemic heart disease and left ventricular hypertrophy from hypertensive heart disease. Respiratory diseases were also noted as causes of OHCA in South Africa<sup>24</sup> and Libya,<sup>21</sup> and obesity was noted as a potential factor leading to OHCA in Togo.<sup>18</sup>

### First aid training and bystander action

Five papers reported on first aid training and bystander action, identifying the importance of implementing proper CPR training.<sup>25–29</sup> Two of these five papers (40%) were again based in Nigeria. Looking at public attitudes towards performing CPR in Ghana, it was reported that most study participants were willing to perform CPR, and that bystander engagement would likely be increased by contextualised training. More than 90% of participants indicated interest in receiving CPR training.<sup>25</sup> Similarly, a study looking at first aid training for school children in sub-Saharan Africa developed an informed educational training pathway for first aid that was piloted in Zimbabwe and has the potential to ultimately improve outcomes.<sup>26</sup> In Nigeria and South Africa, studies found that most participants felt trainings should

be provided in order to improve resuscitation, especially for teachers in the school setting.<sup>27,29</sup> The South Africa study also identified major barriers to bystander CPR, including fear of being sued if something goes wrong, presence of secretions, fear of injury to the victim, fear of contracting a disease from the victim and belief that someone else would do it. Furthermore, participants were more likely to provide CPR for immediate family or children rather than adult strangers.<sup>29</sup> In investigating the availability of basic life support (BLS) courses for lay people in Nigeria, it was found that there are 21 times fewer courses compared with the UK, and of those available, only seven adhere to American Heart Association (AHA) guidelines. The mean cost of participation was also greater than monthly minimum wage, demonstrating a clear barrier to accessing BLS training.<sup>28</sup>

### EMS resuscitation and training

Five papers reported on EMS resuscitation and EMS training.<sup>30–34</sup> The majority of these five papers (60%) were based in South Africa, classified as an upper middle-income country by the World Bank. One study based in Botswana investigating the needs for training of prehospital providers found that cardiovascular emergencies represented the fourth most frequent reason for response calls.<sup>31</sup> Looking at knowledge of EMS teams in South Africa, it was discovered that the sector of employment (public or private), place of training and type of guidelines according to which participants were trained are the main categorical factors that influenced knowledge of CPR.<sup>32</sup> Skill was influenced by the most recent type of CPR training and guidelines used for training.<sup>32</sup> In Tunisia, quantitative data related to arrival at the scene determined that 8% of OHCA victims received bystander CPR, while median time elapsed to arrive at the scene by EMS was 13 min. The decision to resuscitate was based primarily on no flow time (time between cardiac arrest and initiation of CPR) rather than presumed aetiologies.<sup>34</sup> In South Africa, Stein found that the median response time for OHCA cases was 9 min, and bystander CPR was performed in 36% (n=74) of cases.<sup>23</sup> In a separate paper, he also concluded that exposure of South African paramedic students to prehospital cardiac arrest cases or training for such cases was low, with only 50% of first-year and second-year students and 75% of third-year students having any exposure to adult cardiac arrest cases.<sup>30</sup> In looking at the practice of basic adult or paediatric resuscitation procedures, less than half of the studied paramedic students successfully completed the procedure.<sup>30</sup> Another South African study sought to develop quality indicators (QIs) for prehospital emergency care and included QIs for OHCA. QIs specific to OHCA included process measures related to epidemiology and presentation, CPR and treatment measures and outcome measures.<sup>33</sup>

### DISCUSSION

The aim of this study was to describe and summarise the body of literature pertaining to OHCA in Africa. While

many sources were investigated, there were few papers that addressed the question adequately by reporting on all Utstein variables. The evidence fell into three categories: epidemiology and underlying causes for OHCA, first aid training and bystander action, and EMS resuscitation and training.

Epidemiology is a particularly important category to consider when discussing OHCA in Africa. All papers in this category pointed to CVD as an underlying cause for OHCA. The incidence of CVD is expected to double on the continent, which will invariably result in an increase in the number of victims of OHCA.<sup>13</sup> Evidently, a solution for OHCA in Africa must be developed as it becomes an even more prominent issue. The data on epidemiology and underlying causes for OHCA found in this study, however, are not entirely adequate and do not comply with reporting standards. Utstein reporting is important in that it provides a structured outline of variables to compare systems of care for cardiac arrest.<sup>35</sup> Out of the nine papers in this category, none of them reported on all Utstein variables, and four did not report adequately on any. This demonstrates the need for standardised reporting in literature and standardised OHCA registries, in order to allow for a full, context specific picture of OHCA in Africa. Without the context of the Utstein variables, data can easily be interpreted incorrectly.

The overwhelming evidence for CVD as one of the underlying causes of OHCA also indicates that in order to decrease rates of OHCA, factors contributing to CVD must also be addressed. This may involve targeting structural factors preventing a healthy diet and ability to exercise as well as encouraging individuals to stop smoking or drinking excessively.<sup>36</sup> To this end, controlling chronic diseases and emphasising primary care is also necessary. Cost-effectiveness of implementing such programmes should also be addressed. The likelihood of poor outcomes for OHCA victims, which still persists even in some of the most well-resourced settings, must be taken into consideration. This is especially true in African settings where resource constraints and competing population health issues point to the urgent need for a rational approach to the allocation of limited resources.

The five papers that focused on bystander action and first aid training all pointed towards the potential for training programmes to increase bystander participation and knowledge, which could result in improved outcomes. Most barriers to care (fear of injury to the victim, fear of contracting a disease from the victim and belief that someone else would do it) could be overcome through organised training and courses. In an editorial, Monsell rejects the claim for increased CPR training and argues that it is unethical to teach CPR in a low-resource setting, as the links to the chain of survival in such a setting are absent and resources are diverted from other potentially beneficial healthcare activities. It appears that training programmes and the implementation of policies to increase the amount of appropriate equipment such as defibrillators could address the many deficiencies that

Monsell points out.<sup>37</sup> However, even when CPR is initiated properly by bystanders, concerns regarding the robustness of the chain of survival remain: if this chain cannot be completed, then the effectiveness of CPR to improve patient outcomes is negligible or uncertain at most. Furthermore, the lack of appropriate and affordable BLS courses demonstrates that effective planning of trainings must consider accessibility to the general population, and follow appropriate contextual solutions.

The five papers reporting on EMS resuscitation and training revealed the need for appropriate training and learning environment for paramedic students. The frequency of calls received for cardiovascular emergencies further demonstrates the need for adequate training for response teams, specifically for victims of OHCA and other cardiovascular incidents. Improving response time of EMS would likely improve the number of survivors of OHCA, as would standardising the guidelines that students learn under for context-specific settings. Simply stating the need for the augmentation of effective training, however, does not address the complexities involved. In countries with no out-of-hospital emergency care systems, there are no individuals available to train. There is an existing bias in the papers that have been extracted for this study—only settings with a formal EMS system publish on OHCA. As a result, the existing literature has pointed to the need for training, but countries in which there is no existing system for out-of-hospital care, which may have different needs, do not publish on this topic. Having representation is essential to ensure the recommendations being made are done so with a context-appropriate lens. Two of the papers in this category did not have African primary authors and fewer than half of the authorship team representing Africa. With no representation from the country of study nor statement of dissemination, it is difficult to ascertain if the data were applied towards meaningful changes. This points to a need for efforts to build capacity with local authors to strengthen the sustainability of findings or to guard against the paternalistic application of solutions that are not appropriate.

Overall, the evidence suggests the potential to ultimately reduce poor outcomes of OHCA in Africa through increased efforts to address CVD and to implement proper bystander and EMS training. However, it is important to note that behind this recommendation lies very little evidence, making it difficult to find a basis for policy decisions. Before addressing these factors, there is a need to compile more evidence through clinical or epidemiological studies that follow standardised reporting methods. It is also important that research and policies should continue to be context-specific. Implementation of suggested policies could have a different sociocultural impact in each country, and even within a country itself in rural, peri-urban and urban areas. In order to provide responsible guidance, ethical guidelines must also be followed through strong community engagement and inclusivity.<sup>38</sup> It will likely be a long time before it will be cost-effective and beneficial to invest in policies targeting OHCA.<sup>39</sup> Nonetheless, there is an urgent need

to address the increasing incidence of OHCA in Africa while strengthening all parts of the chain of survival in a context-aware manner that emphasises engagement from community members and is tailored towards the local disease burden—which might not be OHCA.

There are limitations to this study that primarily lie in the inclusion criteria and the databases interrogated. Although four databases were searched, some papers and grey literature may not have been included. However, because the selected collection of databases covers such a wide base, it is likely that few studies are omitted.<sup>40</sup> Only papers published in English were included, meaning we may have missed French, Arabic or other language articles. Furthermore, only academically published literature was included, which overlooks non-academic literature such as policy reports that may speak to the effectiveness of policy implementation targeting OHCA.

## CONCLUSION

There is an ongoing global effort to improve aspects of the chain of survival, but scarce data in Africa makes such improvements difficult. The main themes observed in this study were epidemiology and underlying causes for OHCA, first aid training and bystander action, and EMS resuscitation and training. Future research should endeavour to include local representation in authorship teams and focus on robust routine data collection and compliance with Utstein reporting standards. Once rigorous epidemiological reporting provides data that gives a full picture of OHCA in African countries, context-specific research may then target interventions which strengthen the entire chain of survival. In the interim, it is essential to understand community and EMS provider views on OHCA in order to develop robust, representative ethical guidance on how to proceed.

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**Contributors** The study was conceived by WS. JT, in collaboration with KW and WS, did the analysis and wrote the first draft. All authors (JT, KW, WS and LAW) contributed to the outline and revisions of the manuscript. WS is the guarantor.

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