mHealth and Health Care Service Delivery in Africa: A Systematic Review

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Abstract

We conducted a systematic review of studies on mHealth and health care services delivery that were carried out within Africa. Our search process was through MEDLINE, and then on PubMed, we searched key terms based on various keywords: "*Whatsapp, health, Africa, Text messages, health impact, Africa, mHealth tools, Africa*". This was done in December of 2018. Only English written articles from journals indexed in Science Citation Index Expanded and Social Science Citation Index were incorporated in this review. In line with our inclusion criteria, only a total of 19 out of 155 studies were relevant. Inferences from these studies showed that mHealth tools are speedy and quality means for health care delivery in Africa. We also found out that there is less usage of internet devices in Africa as suspected. There is a serious need for improvement in the use of other online based mHealth tools as it was found that the use of Short Messaging Service (SMS) has been the nearly the sole mHealth intervention utilized in Africa. This, it is believed would foster better wider intervention and implementation of quality health outcomes in Africa, and other low and middle-income regions of the world.

Keywords: Africa, mhealth, whatsapp, text messages, health care

1. Introduction

Two quick submissions:

"The African communications 'revolution' has been remarkable: by the end of 2013, mobile phone penetration rates were estimated to have reached 80%, and a recent World Bank report (2014) noted that more Africans now have a mobile phone than have a toilet. Although only 11% of phones in Sub-Saharan Africa currently have fast internet access (3G), this proportion is rising rapidly as costs fall and demand increases" (Hampshire et al., 2015:1).

"Sub-Saharan Africa is seeing an accelerating migration to mobile broadband capable connections. The next couple of years are a key tipping point as 2G connections become a minority of the region's total connections base. 3G will emerge as the dominant technology in the region over the next few years, accounting for 60% of Sub-Saharan Africa's connections by the end of 2025. GSMA Intelligence forecasts the first commercial 5G services to be launched in the region by 2021, with 5G connections accounting for 2.6% of the total connections base by 2025" (GSMA, 2018: 3).

The above statement clearly places Sub-Saharan Africa and the globe in both a current and historical perspective.

The use of technology in enabling speedy and quality access to healthcare services has always been sought after; this means of healthcare delivery bridge the gap within a wide array of healthcare needs faced by the society (Badawy et al., 2016; Badawy et al., 2017; Alquran et al., 2018). These needs could range from dissemination of health information at one end (Pandey et al., 2013; Giodarno et al., 2014), to the performance very complex medical procedures and surgeries at the other extreme (Surka et al., 2014). The use of technology in health has taken various forms like telehealth, telemedicine, eHealth and mHealth (Gustafson et al., 2012; Otu et al., 2016; Andres et al., 2018; Douglas et al., 2018). It should be noted that these all mean different things. While telemedicine and telehealth focus on both exclusive clinical and all-encompassing involvement in healthcare delivery respectively, eHealth and mHealth refer to wide electronic health management and mobile phone/tablet based management of health respectively (Malvey & Slovensky, 2014). Also, due to the ease of the use and the supposed associated low cost of mHealth, it has gained greater prominence over other forms, especially in Africa (WHO, 2018). MHealth is also supposed to use a wide range of services which one's mobile phone/operator can easily offer, especially where there is a relative ease of mobile phone penetration, and a large percentage of the society being underserved on the basis of healthcare provision, as could be seen in most African Nations (Bagayoko et al., 2014). Critical health policy stakeholders at the macro, meso, and micro levels seem to have adopted mHealth in dealing with health issues affecting Sub-Saharan Africa (Little et al., 2013; Githinji et al., 2014; Stanton et al., 2015; WHO, 2018), and this concept has gained a lot of attention due to the obvious belief that the number of mobile devices has grown exponentially in the region (GSMA, 2018).

The use of mHealth technology in healthcare- related activities have gained global attention and has increased access to quality health services (Betjeman et al., 2013; S. Davey & A. Davey, 2014). This has impacted positively on the World Health Organization's six building blocks of health systems, especially on technology and service delivery domains. The operationalization of mHealth is helping to address the barriers to access to health services and the uptake of critical public health interventions in no small measure (S. Davey & A. Davey, 2014). According to Davey and Colleague, developed countries contribute more than three-quarter of the over seven billion mobile phone subscription in the world (S. Davey & A. Davey, 2014).

It is also worth stating that, of all the other technological based support systems for health, mHealth remains the cheapest in assessing hard to reach areas (WHO, 2011; Davey et al., 2014); making it much more sought after as an intervention tool in a region with multiple low and middle-income countries (UN Foundation, 2009). In light of the fact that mHealth is of dual nature-online, especially using smartphones applications, and offline, using text messages and USSD (Unstructured Supplementary Service Data), it is troubling that the focus of mHealth may be bias and skewed towards the use of mainly offline services, denying the populace comprehensive access to the expected benefits of mHealth. This is so because, both Hampshire et al. (2015) and GSMA (2018) describe a very bleak state of internet infrastructure, that is, assuming one was to even downplay the fact that the subscription for constant and high-quality internet services, although unjustified, is a luxury in Africa (see Figure 1). The figure 1 below clearly shows that while the Gross National Income (GNI) Per Capital (P.C) expended on mobile phone internet subscriptions of all global sub-regions have been on the decline, Africa still stands out as being most expensive, even when mobile phone penetration is on the increase.
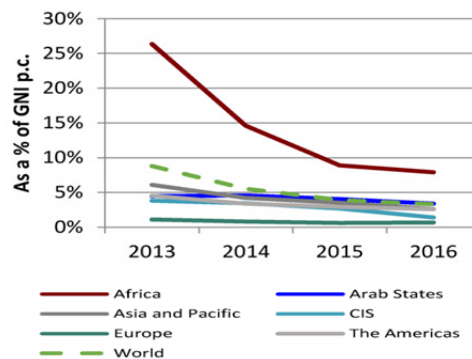

Figure 1. Cost of mobile-based internet subscription-

*CIS (Commonwealth of Independent States)

Source: International Telecommunication Union. (2017) ICT PRICES 2017. Geneva. Retrieved from

https://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-ICT_PRICES.01-2017-PDF-E.pdf   and
https://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2018/ITU_Key_2005-2018_ICT_data_with%20LD
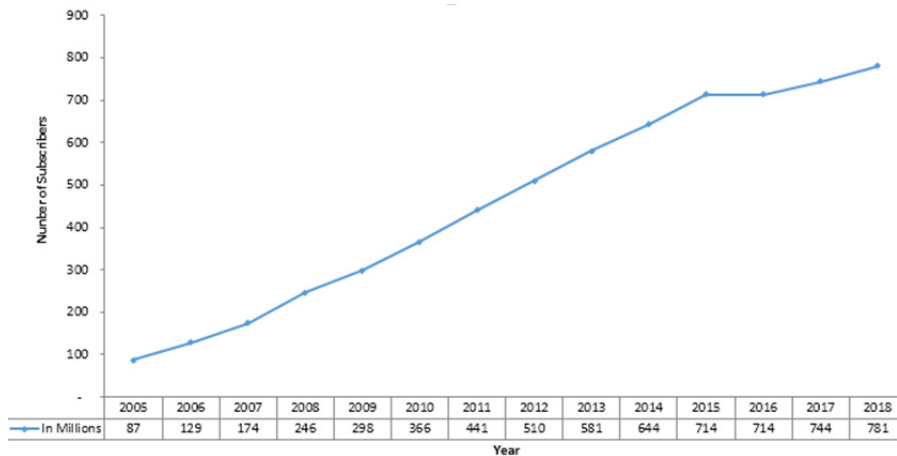Cs_rev27Nov2018.xls

Figure 2. Mobile-cellular telephone subscriptions in Africa

Source: (Lee, Cho, & Kim, 2017; Ronquillo & Currie, 2010; International Telecommunication Union, 2017)

This review focuses on the two prongs of mHealth, one-online, and the other-offline. For the online tool, a review on the use of 'WhatsApp' mobile phone application has been carried out, while for the offline, we restrict our search to 'text messages'. The choice of this scope is borne out of the fact that policy recommendations should be contextualized to suite the several low and middle-income countries in Africa. While there are a plethora of mHealth tools, like Facebook, Instagram, Weibo, Telegram, Twitter, Snapchat, Vimeo, Viber amongst others, WhatsApp has been known to address issues of health with relatively low cost and wider reach (WHO, 2011; Giodarno et al., 2014; Pentapati et al., 2015; Khanna et al., 2015; Johnston et al., 2015; Boulos et al., 2016). Text messages, on the other hand, are also low cost, and while it may not be the only offline based mhealth tool, it has been well used as an intervention (WHO, 2018).

2. Methods

The Preferred Reporting Items for a Systematic Review and Meta-analysis checklist protocol was used for the review (Mother et al., 2015)

2.1 Search Strategies

Systematic reviews of published quantitative literatures were conducted. The searches were conducted following an adaptation of Pubmed and Google Scholar databases. Additional search was done using Snowballing method. The search was carried out on December 2018. The following search terms were used: *"Whatsapp", "health", "Africa", "Text" "messages", "health", "impact", "mHealth", "tools".*

2.2 Inclusion Criteria

Only intervention studies published in English and conducted in Africa were eligible for inclusion. Studies published between 2010 and 2018 were included in the review. Also included in the review were articles published in highly ranked journals indexed by Science Citation Expanded/Social Science Citation Index. More so, only empirical studies that discuss the relationship between mHealth and health care service delivery were included in the review. This was to ensure that our results were evidence-informed.

2.3 Exclusion Criteria

Non-intervention articles and studies conducted outside Africa were excluded. Also excluded from the review were studies published in other languages other than English language.

2.4 Data Extraction

A data extraction form developed by us was used for the review. Included articles were exported to Mendeley

reference manager to keep take track of the references. The following domains were included in the data extraction form: Author and year of publication, Country, Information tool, Health issue/samle, Impact assessed, Types of study, Intervention used, and Policy Implication

2.5 Evidence Generation Method

For the evidence we utilized in this review, we adopted a systematic search in December 2018, this search was performed thus; first, using MEDLINE, and we narrowed our search to PubMed. Our search fell into three major categories/keywords:

Category 1: "*Whatsapp, health, Africa*" = 20 Publications;

Category 2: "*Text messages, health impact, Africa*" = 65 Publications;

Category 3: "*mHealth tools, Africa*"= 70 Publications.

We also performed a Snow-balling exercise that enabled us to manually select the work of Lester et al., (2010). Furthermore, although not through the conventional manual perusal of the references of a study, during the search protocols of the various search terms, four (4) other studies (Greishman et al., 2014; Ha et al., 2016; Haricharan et al., 2017; Kop et al., 2018) were added to the pool of articles we reviewed. These were seen at the "similar articles" and "cited by PubMed central articles" section, and were scrutinized on the basis of strict inclusion rules as having been stated above.
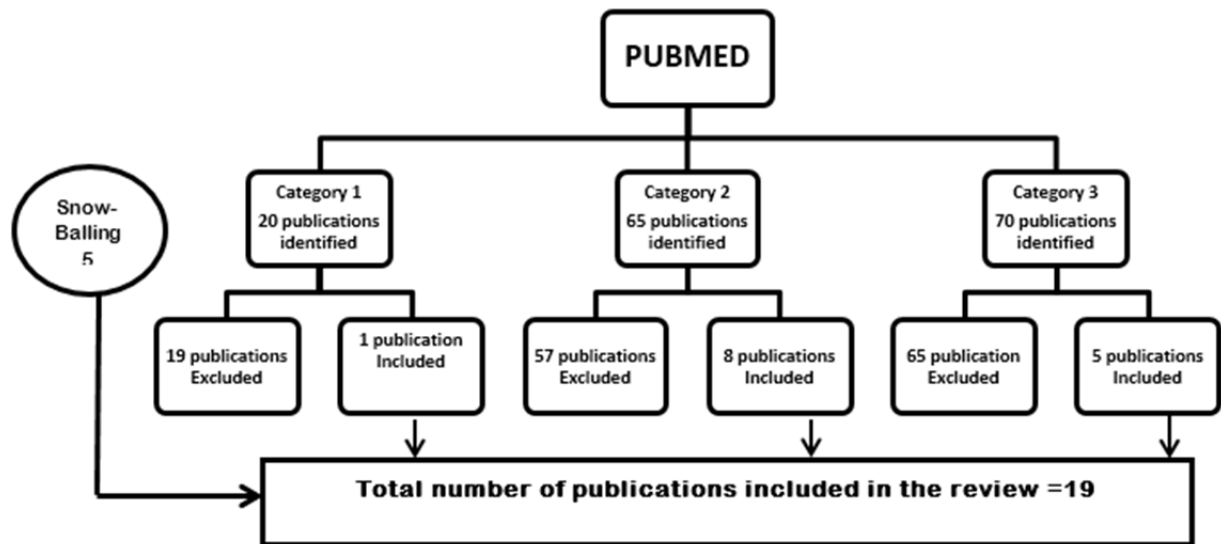

Figure 3. Method Design

Flow chart showing detailed article extraction and evaluation method (Uneke et al., 2016; Okedo-alex et al., 2019; Onwujekwe et al., 2019).

Table 1. Study characteristics of articles reviewed

Authors and Year of Publication	Country	Information Tool	Health Issue/Sample	Impact Assessed	Types of Study	Internet Use	Policy Implication
Pimmer et al. 2017	Malawi	WhatsApp	Mobile instant messaging for rural health workers	Enhanced ease of connectedness.	Survey	Yes	WhatsApp can close the gap between patients & clinicians
Greisman et al. 2014	Uganda	Smartphone-based teledermatology consult services	Tele-dermatology among Medical students	Smartphone-based systems are feasible for delivery of cases	Evaluation	No	Smartphone-based teledermatology is cost effective
Ha et al. 2016	Botswana	Mobile phone or tablet app and online database	Time Assessment of in completing TB contact	Mobile Health approach reduce completion time	Evaluation	No	mHealth is beneficial for tracking TB
Georgette et al. 2017	South Africa	SMS	Weekly use of SMS for Anti-Retroviral Therapy	Small measurable clinical impact	Retrospective cohort study	No	SMS is effective in enhancing enrollment
Finocchario-Keder et al. 2014	Kenya	HIV infant tracking system (HIT system)	Evaluation of the impact of HCT for quality	A significant increase in the proportion of HIV-infected infants that started ART.	Before-and-After study	No	HIT system can improve the quality and efficiency of HIV care
Haberer et al 2016	Uganda	SMS reminder	Exploring the effects of SMS plus real-time adherence	SMS increased adherence in initiating ART	Randomized control trial	No	Implementation of SMS can enhance ART adherence
Lester, et al. 2010	Kenya	SMS	Assessment of mobile communication in starting ART adherence.	Adherence improved with weekly SMS reminders	Randomized clinical trial	No	SMS support can significantly improve drug adherence.
Haricharan, et al. 2017	South Africa	SMS	Assessment of SMS-based campaign	SMS improved Deaf people's knowledge of hypertension	Pre-test – post-test survey	No	SMSs can be effective knowledge
Kop, et al. 2018	Kenya	SMS	Weekly SMS intervention in retention	No improved retention	Randomized Parallel-group study	No	SMS has a role in improving self-perceived health quality
Liu et al. 2016.	Nigeria	SMS reminder messages	Evaluation of SMS reminder messages for treatment adherence	SMS reminder increased treatment adherence	Survey	No	Implementation of policy on text message can be effective for treatment adherence.

Table 1. Cont'd

Authors and Year of Publication	Country	Information Tool	Health Issue/Sample	Impact Assessed	Types of Study	Internet Use	Policy Implication
Mushamiri et al. 2015	Kenya	SMS	End-User changes in health-seeking behavior	mHealth tool strengthened adherence to ANC	Evaluation	No	Incorporating mHealth tools in CHW programs can improve adherence to ANC and enhance PMTCT efforts
Rokicki, et al. 2017	Ghana	Mobile phone quiz	Assessment of the degree to which mHealth programs reach target adolescent	Increased SRH knowledge among adolescent girls	Case-control survey.	No	Mobile phone quiz has the potential of increasing adolescents' knowledge
Jian, et al. 2012	Swaziland	SMS	Using SMS to reduce Turnaround Time (TAT)	Improved TAT with SMS than paper-based	Implementation	No	SMS based reporting of lab results has prospect for reducing TAT
Friedman, et al. 2014	Ghana	SMS	Information management of childhood diarrhoea	Improved provider's reported compliance with WHO standards.	Mystery client survey.	No	SMS is effective in providing information that is capable of changing the health provider's behaviors.
Armstrong, et al. 2011	Botswana	SMS	Evaluation of SMS for clinical guidelines	The tool enabled query and review of a country's specific clinical guidelines.	Pre-use Survey.	No	This tool can be used on a long-term basis in areas of limited internet access
Hirsch-Moverman et al. 2017	South Africa	SMS	Use of SMS in providing real-time adherence to patients	SMS was found to be user-friendly and accepted by patients	Mixed-methods implementation study.	No	SMS can inform adherence and retention strategies in managing HIV/TB
Little et al. 2013	Ethiopia	OpenDataKit platform (ODK) using the phone	Evaluation of smartphone technology for delivering health care services	Ownership and use of mobile technology improved the quality of health care	Observational Study.	Partially	Technology-driven healthcare can ensure ownership and empowerment among health workers
Stanton, et al. 2015	Ghana, Malawi	SMS	SMS tools enabled trained community-based health workers to report basic information/Health workers	The tool enabled health workers to monitor the community impact of the SMS efficiently	Case Study design.	No	Community-based health worker are exceptionally well-placed in quantifying lymphatic filariasis with the use of mobile phone
Shahaurka et al., 2014	South Africa	Paper-based and mobile phone risk assessment tool	Evaluation of the use of mHealth tools in Cardiovascular Disease (CVD) primary prevention.	Reduction in CHW (Community Health Worker) training time and risk	A quantitative and qualitative study.		The reduction in CHW training time and lack of error in the calculation of CVD risk score leading to adoption and sustainability

3. Discussion

The positive contributions of mHealth tools like SMS, WhatsApp, Instagram, Facebook, and others in healthcare delivery are evident in most countries of the world. These tools cover both offline and online means of communication. However, it was discovered that the majority of mHealth tools utilization in Africa is offline-based (SMS) with less emphasis on online which would have been more efficiently utilized in Africa if internet services were provided and assessed with relative ease. As a matter of fact, only one work actually focused on the use of WhatsApp in health care delivery (Pimmer et al., 20017); which was adjudged as a cheaper and more reliable as it has an end to end encryption needed for privacy in health communication (Boulos et al., 2016). This is one of the evidence to the fact that internet services in Africa which affects its utilization in the healthcare delivery in the continent.

Moreover, this systematic review revealed that the use of mHealth tools in healthcare services focused more on prevention and care of HIV as against other diseases like Pneumonia, Diarrhea, malaria, Tuberculosis etc. The implication is that in Africa, HIV still receives much attention while pneumonia which has overtaken HIV/AIDS as a major killer disease in Africa has received lesser attention (WHO, 2018). This could well mean that healthcare providers, policy makers, and health researchers have not garnered the use of mHealth tools in curbing the menace of these diseases in Africa. It was also observed that the use of mHealth in Africa was majorly directed towards healthcare workers with less consideration of patients and how the tools should assist them with timely access to healthcare services.

Most African countries have not received the much-needed attention on the use of mhealth tools towards ensuring adequate healthcare service delivery; this was evident in the PubMed search conducted which identified the number of intervention which each country received on the use of mHealth tools. Out of the 39 African countries found during the PubMed search, Kenya received the highest number of works (7) that focused on the use of mHealth which is more than any other country. Ghana and South Africa collectively received 4 works each on the issue under discourse; Uganda followed with 3 works. Botswana, Ethiopia, Malawi, and Nigeria have 2 works respectively; while Mali, Swaziland and Tanzania have 1 work respectively. This showed that only 11 countries (representing 20.37%) out of 54 countries of Africa have received attention on the use of mHealth in healthcare delivery; an indication that mhealth is not positioned on the frontrunner to assist in healthcare delivery in Africa.

4. Policy Implication

Premised on the evidence generated from the systematic review, the under listed policy suggestions have been recommended:

It makes sense to say that policy design and implementation on mHealth should be based on evidence, especially in resource-constrained continents such as Africa. As a matter of urgency, African countries, especially the sub-Saharan countries should adopt and implement mHealth interventions in their health systems with the aim of reducing morbidity and mortality, especially among mothers and children, and the immune-compromised groups.

Whereas attention has been focused more on SMS as feasible mHealth intervention tools by numerous recent studies (Lester et al., 2010; Armstrong et al., 2011; Jian et al., 2012; Friedman et al., 2014; Mushamiri et al., 2015; Stanton et al., 2015; Ha et al., 2016; Haberer et al., 2016; Liu et al., 2016; Haricharan et al., 2017; Hirsch-Moverman et al., 2017; Kop et al., 2018), Whatsapp, Instagram, Facebook, LinkedIn tools also have to be exploited equally without bias (Pimmer et al., 2017). Using systems thinking in driving the mHealth intervention, especially in this era where everybody now sees the internet as the most interesting ecological information niche in getting both colloquial and scientific evidence for health care is apt.

Many countries in Africa are still lagging behind on the use of mHealth tools as drivers for achieving the 'Health for All Campaign' as enunciated by the Ama-Alta Declaration in Kazakhstan (WHO, 1978). mHealth tools should be adopted by all African countries because of its communication viability, ease of use, portability, cost-effectiveness, broad access, acceptability, and sustainability.

African countries should as a matter of policy, make a concerted effort towards transiting to higher internet broadband like the 5G connection, which is in vogue in other more advanced countries of the world at the moment. These concerted efforts must include investments in internet infrastructure, as it has been proven that the internet as a mHealth tool would improve health care service coverage, delivery, intervention, and implementation in Africa (Davey et al., 2014).

There appears to be lacuna for studies that focused on the use of mHealth tools on other diseases like; pneumonia, TB, Malaria, etc. other than the HIV disease. This is as revealed by our PubMed search for empirical works which showed that of the 19 articles reviewed in this study, only a handful were centered outside HIV

(Finocchario-Kessler et al., 2014; Hirsch-Moverman et al., 2017). This is despite the fact that pneumonia which has its causative agent as Streptococcus pneumonia has been adjudged as the leading cause of childhood death globally, killing about 920000 children per year (Whitney, 2017). mHealth tools should not be used linearly for particular groups of diseases. It is a non-linear reliable tools that can be used to drive any health program effectiveness against any type of disease, be it a communicable disease, none communicable disease or neglected tropical disease of Africa. It is therefore recommended that all the researchers in the Issue Network community should start using mHealth as intervention tools in carrying research on any disease in a bid to reducing morbidity and mortality rate in Africa.

5. Conclusion

Despite the records of successes on the use of mHealth in health care delivery in the world, Africa still lags behind other continents of the world. This has largely been attributed to poor access to internet-enabled devices, poor internet services in hard-to-reach settings and general weak health systems. mHealth technology in Africa has rather focused on Short Messaging Services (SMS). Improvement in other aspects of online based mHealth interventions would unarguably scale up the quality and delivery of health care services in Africa.

Author's Contributions

AEE: conception and study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript. CII: study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript. MI: study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript. TAN: study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript. RIA: study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript. ION: study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript. NAE: study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript. UAE: study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript. LEE: study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript. IJN: study design, data extraction, analysis and interpretation of results, manuscript drafting and approval for final manuscript.

Competing Interests Statement

The authors declare that there are no competing or potential conflicts of interest.

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