




BMJ Open Availability and use of mHealth for disease diagnosis and treatment support by health workers in sub-Saharan Africa: a scoping review protocol

Ernest Osei ,¹ Desmond Kuupiel ,^{1,2}
Tivani Phosa Mashamba-Thompson ,^{1,3}

To cite: Osei E, Kuupiel D, Mashamba-Thompson TP. Availability and use of mHealth for disease diagnosis and treatment support by health workers in sub-Saharan Africa: a scoping review protocol. *BMJ Open* 2020;**10**:e036641. doi:10.1136/bmjopen-2019-036641

► Prepublication history and additional material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2019-036641>).

Received 27 December 2019
Revised 14 September 2020
Accepted 22 September 2020



© Author(s) (or their employer(s)) 2020. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

¹Public Health, College of Health Sciences, University of KwaZulu-Natal, Durban, South Africa

²Research for Sustainable Development Consult, Sunyani, Bono Region, Ghana

³Public Health, University of Limpopo, Polokwane, Limpopo Province, South Africa

Correspondence to

Ernest Osei;
ernestosei56@gmail.com

ABSTRACT

Introduction Improving healthcare for all is one of the global health priorities, particularly in disease burdened settings such as sub-Saharan Africa (SSA). Considering the high penetration rate of mobile phones in SSA, mobilehealth (mHealth) could be used to achieve universal health coverage. The proposed study will map evidence on the availability and use of mHealth for disease diagnosis and treatment support by health workers in SSA.

Methods and analysis This review will be guided by Arksey and O'Malley's scoping review framework and Levac *et al*'s recommendations and guidelines from the Joanna Briggs Institute. A scoping review will be conducted to explore what is known about mHealth for disease diagnosis and treatment support by health workers in SSA and to identify areas for future research. In addition to searching the grey literature, the following databases will be explored from PubMed, MEDLINE and CINAHL with full text via EBSCOhost and ScienceDirect databases. A search in Google Scholar will be considered as an additional information source. The literature search will involve published studies from 2000 to 2020 in any language. This review will cover mHealth for disease diagnosis and treatment support by health workers in SSA. The primary investigator will conduct the title screening, and subsequently, two reviewers will independently conduct abstract and full article screening and data extraction. The results of this proposed review will be presented using the Preferred Reporting Items for Systematic Reviews and Meta-analysis: Extension for Scoping Review guidelines.

Ethics and dissemination Ethical approval is not required for the scoping review, which is the first stage in a PhD study in public health on accessing mHealth for disease diagnosis and treatment support by health workers in Ghana. The final review will be submitted for publications to a scientific journal, and our results will be presented at appropriate conferences.

BACKGROUND OF THE STUDY

The mass availability and use of mobile health (mHealth) technology provide a significant potential for such technologies to be integrated into clinical services to support quality medical care.¹ WHO, through its

Strengths and limitations of this study

- The scoping review will use a well-established, rigorous scoping review methodology with a comprehensive strategy.
- The literature search will be comprehensive, including electronic databases with peer-reviewed literature and grey literature sources, including governmental as well as non-governmental websites.
- In this scoping review study, language and study design limits will be removed.
- The review will be limited to studies published from 2000 to 2020.
- This review study was also limited to studies conducted within sub-Saharan Africa, which may lead to missing other relevant articles.

global observatory report defined mHealth as 'medical and public health practice support by mobile devices like mobile phones, smartphones, tablets, patients monitoring devices, personal digital assistants and other wireless devices'.² In 2015, it was estimated that 52% of smartphone users gather health-related information like a medical problem, nutrition, depression, among others on their mobile phones.³ In sub-Saharan Africa (SSA), mobile phone availability, and utilisation by the population at the end of 2017 was 44% and is forecast to reach 52% by 2025.⁴ mhealth technologies and applications are available and being utilised for screening diseases, medication adherence, follow-ups, appointment reminders and many others.^{5 6} Given the large availability and utilisation of mobile phones, mHealth technologies and applications could be explored to supplement the provision of healthcare services in SSA.

Research has shown that the use of mHealth can result in some of the following health benefits: first, mHealth has the potential to



improve the provision of quality healthcare by enhancing treatment, empowering patients, reducing medical cost and streamline the use of health resources.¹ mHealth in the form of text messages and voice calls given to patients could help healthcare workers to monitor patients' health conditions remotely and assist them in complying with treatment procedures.⁷ It could save both patients and health providers' time, reduce patients' costs and improve doctor-patient relationships through regular interactions.⁸ mHealth applications like reference apps, diagnostic apps and others could help healthcare workers to be more proactive in addressing their patients' health conditions.⁹ mHealth could also assist patients to receive healthcare services in real time to prevent late detection of diseases, improves poor clinical outcomes and several others.⁹ mHealth promotes maternal and child health, and routine immunisation.¹⁰ It also encourages proper self-chronic disease management and the general wellness of patients.¹

Although a lot has been published on the potential benefits of mHealth technologies and applications in SSA,⁸⁻¹¹ the uptake of mHealth has been faced with several challenges and barriers. Prominent among the challenges is the inadequate Information and Communication technology (ICT) trained healthcare professionals who could effectively use mHealth applications.¹² Research has shown that a significant population of people in countries within SSA are illiterate and are poor digitally.¹² Other studies have demonstrated that the small size of the mobile phone screen, the quality of image, poor network connection in transmitting data and weak legislation are some of the challenges affecting mHealth in SSA.¹²⁻¹³ In addition, other challenges of mHealth applications in SSA are technical, financial and infrastructural barriers, data security and the accuracy of mHealth diagnostic tools.¹⁴ Similar implementational challenges are technology usability, sustainable funding, learning environment, the culture of information use and cost-effectiveness.¹⁵

Sustainable Development Goal 3.8¹⁶ target has emphasised the importance of accessing quality, safe, effective and affordable universal health for all. To achieve this goal, mHealth interventions could be adopted to support universal healthcare provision in all settings despite some of these implementational challenges and barriers. mHealth interventions could be used by front-line health workers to provide healthcare to patients living in hard-to-reach communities with insufficient or no healthcare facilities. Studies have demonstrated that mHealth has contributed to achieving Universal Health Coverage in both resource-poor settings and resource-rich settings.¹¹⁻¹⁷⁻¹⁸ People living in resource-poor settings in SSA may not have access to quality healthcare because of bad roads, inadequate health facilities and inadequately skilled workers, among others.⁹ To this end, mHealth could be adopted by health workers to support healthcare delivery in such communities since it can reach many more people faster than the traditional way of controlling diseases.

Previous reviews focused on mHealth for data collection, reminders, health education, communication, disease surveillance, medication adherence, exchange of patients' data between health workers or between patients and their health providers and effectiveness of using mHealth applications in SSA.¹⁹⁻²³ A review on the availability and use of mHealth for disease diagnosis and treatment would be valuable towards improving access to healthcare services, especially in this era of COVID-19. Despite this, the available evidence illustrates that no previous review has been conducted focusing on mHealth applications for disease diagnosis by health workers in SSA. Therefore, this current review will aim to map existing evidence on the availability and use of mHealth for disease diagnosis and treatment support by health workers in SSA.

METHODS

Protocol design

We will carry out a scoping review of evidence on the availability and use of mHealth for disease diagnosis and treatment support by health workers in SSA under the guidance of Arksey and O'Malley's framework,²⁴ Levac *et al*²⁵ and the 2015 Joanna Briggs Institute²⁶ guidelines. A five-step structure from Arksey and O'Malley includes the following:

1. Identify the research question.
2. Identifying relevant studies.
3. Selection of studies.
4. Data charting.
5. Collating, summarising and reporting the results.

This scoping review will be conducted following guidelines from the Preferred Reporting Items for Systematic Reviews and Meta-analysis: Extension for Scoping Reviews (PRISMA-ScR, [figure 1](#)).²⁷ This protocol has been reported according to the guidelines provided by Preferred Reporting Items for Systematic Reviews and Meta-Analysis Protocols (PRISMA-P, online supplemental additional file 1).

Step 1: identify the research question

The research question of interest is: What evidence exists on the availability and use of mHealth for disease diagnosis and treatment support by health workers in SSA?

The subresearch questions are as follows:

1. What evidence exists on the availability of mHealth for disease diagnosis and treatment support by health workers in SSA?
2. What evidence exists on the use of mHealth for disease diagnosis and treatment support by health workers in SSA?

The Population, Concept and Context framework developed by Joanna Briggs Institute²⁶ has been used to determine the eligibility of the research question for our scoping review ([table 1](#)).

Step 2: identifying relevant studies

For the identification of relevant articles, an electronic database search will be carried out using advanced search

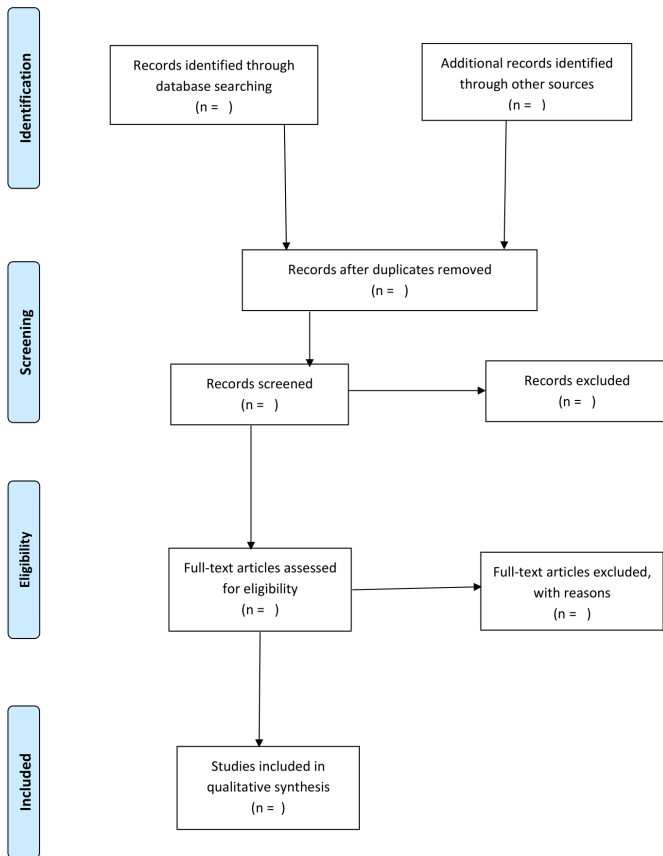


Figure 1 PRISMA-ScR flowchart, which demonstrates the literature search and study selection processes. PRISMA-ScR, Preferred Reporting Items for Systematic Reviews and Meta-analysis: Extension for Scoping Reviews.

from the following databases: MEDLINE and CINAHL with full text via EBSCOhost, PubMed and ScienceDirect. A search in Google Scholar will be considered as an additional source of information. We have sought advice

from the University of KwaZulu-Natal Library Service for selecting relevant databases for this study and with keywords searches. WHO website and the departments of health websites will also be searched thoroughly for relevant literature. Reference lists of all included articles will also be searched for relevant articles. Keywords for searching the literature will be: ‘mHealth technology’, ‘disease’, ‘diagnosis’, ‘treatment’, ‘support’ and ‘sub-Saharan Africa’. Boolean terms (AND, OR) will be used to separate the keywords. Medical Subject Headings terms will also be used during our electronic search for relevant articles.

We have carried out a pilot search in PubMed to show the feasibility of conducting the proposed scoping review method (table 2).

Inclusion criteria

We will include the following:

1. Studies involving healthcare workers using mHealth.
2. Articles presenting findings on mHealth interventions such as text message, voice calls, mobile apps and multimedia messaging among others.
3. Articles that report findings on the availability of mHealth for disease diagnosis.
4. Articles that present findings on the availability of mHealth for treatment support.
5. Articles presenting findings on the use of mHealth for disease diagnosis.
6. Articles reporting findings on the use of mHealth for treatment support.
7. Articles that present findings on mHealth from SSA.
8. Primary research studies on qualitative, quantitative, mixed-method, randomised controlled trials and non-randomised controlled trials, and grey literature.
9. All articles published from 2000 to 2020 in any language.

Table 1 Determining the eligibility of the research question

Determinants	Description
Population	Healthcare workers —this includes all the various categories of trained health workers such as physicians, nurses, community health workers, pharmacists/dispensing technicians, biomedical scientists/laboratory technicians, radiologists, physiotherapists, occupational therapists, speech therapists, disease control officers and others working in healthcare facilities within SSA. These are the group of professionals who have been given the requisite skills and training in providing healthcare services to the public. Some of these healthcare professionals have been given additional skills on how to use mHealth applications to render quality healthcare services to their clients.
Concept	Disease diagnosis and treatment support Disease diagnosis —the use of mHealth applications to assist in identifying the nature of an illness or any other problem by examining the symptoms. These mHealth applications could help in screening patients' conditions or cases to detect any form of diseases, disorders or injuries. Treatment support —the use of mHealth applications to assist patients in treating and managing their conditions in terms of medication adherence, appointment reminders, follow-ups, communication, health monitoring, prevention and others without travelling to the health facility.
Context	Availability and use in SSA Availability —is the state of being able to access, use and obtain mHealth applications on a demand to perform the required functions such as disease screening and diagnosis, treatment and medication adherence, follow-ups, maternal and child health, appointment reminders and others. Use —the process of employing mHealth applications to accomplish tasks such as diagnoses and screening of diseases, treatment and management of conditions of patients.

mHealth, mobile health; SSA, sub-Saharan Africa.

Table 2 Draft search for PubMed/MEDLINE

Date of search	Search engine used	Keywords search	Number of publications retrieved
17 June 2019	PubMed	((('telemedicine'(MeSH Terms) OR 'telemedicine'(All Fields) OR ('mobile'(All Fields)((('telemedicine'(MeSH Terms) OR 'telemedicine'(All Fields) OR ('mobile'(All Fields) AND 'health'(All Fields)) OR 'mobile health'(All Fields) AND ('technology'(MeSH Terms) OR 'technology'(All Fields) OR 'technologies'(All Fields))) AND (('disease'(MeSH Terms) OR 'disease'(All Fields)) AND ('diagnosis'(Subheading) OR 'diagnosis'(All Fields) OR 'diagnosis'(MeSH Terms)))) OR (('therapy'(Subheading) OR 'therapy'(All Fields) OR 'treatment'(All Fields) OR 'therapeutics'(MeSH Terms) OR 'therapeutics'(All Fields)) AND support(All Fields)) AND 'health'(All Fields) OR 'mobile health'(All Fields) AND ('technology'(MeSH Terms) OR 'technology'(All Fields) OR 'technologies'(All Fields))) AND (('disease'(MeSH Terms) OR 'disease'(All Fields) AND ('diagnosis'(Subheading) OR 'diagnosis'(All Fields) OR 'diagnosis'(MeSH Terms)))) OR (('therapy'(Subheading) OR 'therapy'(All Fields) OR 'treatment'(All Fields) OR 'therapeutics'(MeSH Terms) OR 'therapeutics'(All Fields)) AND support(All Fields))	932

MeSH, Medical Subject Headings.

Exclusion criteria

The following will be excluded:

1. Studies involving patients using mHealth applications.
2. Articles reporting findings on eHealth applications such as medical health records, personal health records and many others.
3. Articles that report findings on mHealth for health education.
4. Articles reporting findings on mHealth for data collection without diagnosis and treatment support of conditions.
5. Articles that present findings on mHealth for communication without disease diagnosis and treatment support of conditions.
6. Articles reporting findings on mHealth outside SSA.
7. Review articles.

Step 3: selection of studies

Following database searches for relevant articles, the principal investigator, EO, will carry out a comprehensive study title screening. All eligible study titles will be exported to an Endnote X9 library purposely created for this scoping review. All identified duplicates will be deleted before sharing the Endnote library with the review team. Two trained reviewers (EO and DK) will independently conduct abstract screening in parallel using the screening tool, which will be designed with guidance from the inclusion and exclusion criteria. The review team will discuss discrepancies between the two reviewers' responses at the abstract screening stage until a consensus is reached. Two reviewers (EO and DK) will perform the full-article screening using the eligibility criteria guided tool for the selected relevant articles. A third reviewer (TPM-T) will be contacted to resolve discrepancies in reviewers' responses following full-article screening. The library services at the University of KwaZulu-Natal will be requested to support

our study search strategy to help retrieve full articles that were not accessible in the databases, as mentioned earlier. The screening results will then be reported using the PRISMA flow diagram.²⁷

Step 4: data charting

A data charting form will be used to extract all the relevant data from the included articles (box 1).

The data extraction form will be validated by two reviewers using at least the first five articles for consistency. We will update and modify the data extraction form throughout the study. Two reviewers (EO and DK) will independently conduct the data extraction in parallel. The standard bibliographical information (ie, authors, title and year of publication), geographical setting, study setting, study design and aim of the study will be reported. For each of the included primary studies, information on the target population, type of technology,

Box 1 Data charting table

- ▶ Author and date
- ▶ Country
- ▶ Aim of the study
- ▶ Geographical setting
- ▶ Study setting
- ▶ Study design
- ▶ Study population
- ▶ Type of technology
- ▶ Purpose of mHealth
- ▶ Disease diagnosis
- ▶ Treatment support
- ▶ Key findings of the study
- ▶ Most significant findings of the study
- ▶ Conclusions
- ▶ Notes

type of mHealth intervention, the purpose of mHealth, disease diagnosis, treatment support, key findings, most significant findings, conclusions and notes will be tabled. NVivo V.12 software package will assist us in conducting thematic content analysis²⁸ from the relevant outcomes of the included articles.

Quality appraisal of studies

The electronic version of the mixed-method appraisal tool (MMAT) V.2018²⁹ will be adopted to assess the quality of the included primary studies. The MMAT will be used for quality appraisal and describes the quality of the methodology for qualitative, quantitative and mixed-method studies. In this quality appraisal, we will examine the aim of each study, clarity of the research question, appropriate methodology, study design, relevant data sources, proper sampling technique, suitable data collection procedures and participant recruitments. Others include representativeness of population, the suitability of statistical analysis of data, appropriateness of data interpretation, authors' acknowledgement of potential biases, presentation of findings, discussions and the authors' conclusions of all the included primary studies. A quality appraisal will be conducted to understand the strengths, weaknesses, potential for bias in clinical research as well as the quality of research evidence which will be presented from each of the included primary studies. Generally, the quality of all the selected studies will be calculated and rated using the MMAT guidelines for the low quality of 25%, the average for 50%, above average for 75% and the high average for 100%.

Step 5: collating, summarising and reporting the results

This study's main aim is to map available evidence and summarise the findings as reported across all the included articles. We will conduct a thematic content analysis²⁸ with the support of NVivo V.12 of the included studies. The review team will carefully analyse the emerging themes and relate them to our research question. The reviewers will also analyse all the implications on the significant findings with regards to the research question and stimulate future research in SSA. We will present a narrative account of all our results according to the themes.

DISCUSSION

This scoping review will map evidence on existing literature on the availability and use of mHealth for disease diagnosis and treatment support by health workers in SSA. The WHO, through its global observatory 2016 report, indicated mHealth as one of the new emerging technologies that could help achieve universal health for all.³⁰ According to WHO, mHealth services like short message reminders and phone calls can easily be made available to remote populations and resource-limited settings by providing mechanisms for the exchange of data between patients and service providers.³⁰ Research has also shown that mHealth can help increase access to healthcare and

the provision of healthcare in communities with limited infrastructure to support the internet or traditional healthcare services.^{2 30 31} Providing healthcare through mobile communication is reported to be cheaper than supplying in-person healthcare services.³⁰ Recent studies demonstrated that mHealth services helped patients, especially those in hard-to-reach communities stick to treatment procedures, appointment adherence and many others.^{6 32} Considering these benefits of mHealth, there is the need to map evidence on the availability and use of mHealth for disease diagnosis and treatment support by health workers in SSA.

This scoping review will be limited to articles presenting findings from SSA because of the similar health challenges. Our study will not cover articles outside of SSA because they have different health targets and problems. The study will exclude articles presenting findings on mHealth used by patients because we want to examine the impact of mHealth usage by health workers to support healthcare delivery. Also, this study will exclude articles presenting findings on mHealth for communication in terms of health promotion campaigns or community mobilisation to raise awareness of target groups. Again, our proposed research will exclude articles presenting findings on mHealth for providing medical education to health workers on professional development. This study will cover articles that offer evidence published from 2000 to 2020 to obtain current information on the reports of mHealth applications. The findings of this scoping review study will be published in a peer-reviewed journal.

Patient and public involvement

No patient and the public will be involved in our study design, conducting and dissemination of the results of the scoping review.

CONCLUSION

This article provides a scoping review protocol with a comprehensive and detailed methodology. The review includes both peer-reviewed articles and grey literature, which will contribute to research on mHealth for disease diagnosis and treatment support by health workers in SSA. This scoping review will provide existing evidence on the availability and use of mHealth by health workers for disease diagnosis and treatment support in SSA. The results of this proposed study will reveal gaps in the literature, influence policymakers, contribute to existing knowledge and improve healthcare delivery in SSA.

This scoping review is a part of a large study aimed at examining the accessibility of mHealth for disease diagnosis and treatment support by health workers in Ghana.

ETHICS AND DISSEMINATION

This scoping review methodology requires collecting, reviewing and synthesising materials from all available publications; no ethical approval will be required. The

final review will be published in a scientific journal. The results of this review will be presented at appropriate conferences and workshops.

Acknowledgements The authors wish to thank the University of KwaZulu-Natal for giving all the necessary resources in developing this study protocol.

Contributors EO and TPM-T conceptualised this study and the methodology. EO wrote the first draft, and DK and TPM-T critically reviewed the manuscript. All authors (TPM-T, DK and EO) reviewed the final drafted manuscript and approved it.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Ernest Osei <http://orcid.org/0000-0002-8536-545X>

Desmond Kuupiel <http://orcid.org/0000-0001-7780-1955>

Tivani Phosa Mashamba-Thompson <http://orcid.org/0000-0002-4193-2416>

REFERENCES

- Bradway M, Carrion C, Vallespin B, *et al*. mHealth assessment: conceptualization of a global framework. *JMIR Mhealth Uhealth* 2017;5:e60.
- WHO. *mHealth new horizons for health through mobile technologies*, 2011.
- Forrest JI, Wiens M, Kanters S. *Mobile health applications for HIV prevention and care in Africa*, 2015: 464–71.
- GSMA. *Mobile economy sub-Saharan Africa*, 2019.
- Haberer JE, Musiimenta A, Atukunda EC, *et al*. Short message service (SMS) reminders and real-time adherence monitoring improve antiretroviral therapy adherence in rural Uganda. *AIDS* 2016;30:1295–9.
- Nhavoto JA, Grönlund Åke, Klein GO. Mobile health treatment support intervention for HIV and tuberculosis in Mozambique: perspectives of patients and healthcare workers. *PLoS One* 2017;12:e0176051.
- EJOjophi A. *Electronic health in Ghana: current status and future prospects*, 2014: 230.
- Steinhubl SR, Muse ED, EJJStm T. *The emerging field of mobile health*, 2015: 283rv3–rv3.
- Modi S. Mobile health technology in developing countries: the case of Tanzania. *Pepperdine Law Rev* 2013;6.
- Davey S, Davey A, AJJom D. Mobile-health technology: can it strengthen and improve public health systems of other developing countries as per Indian strategies? A systematic review of the literature. *Int J Med Public Health* 2014;4:40.
- Crul S. *The mHealth opportunity in Sub-Saharan Africa - Deloitte open global mobile survey*, 2012: 13.
- Eilu E. *Improving access to health services in sub-Saharan Africa using mobile and wireless technologies*. Current and Emerging mHealth Technologies Springer, 2018: 225–40.
- WHO. *World Health organization guidelines*, 2018.
- Brinkel J, May J, Krumpkamp R, *et al*. Mobile phone-based interactive voice response as a tool for improving access to healthcare in remote areas in Ghana - an evaluation of user experiences. *Trop Med Int Health* 2017;22:622–30.
- Leon N, Schneider H, Daviaud E. Applying a framework for assessing the health system challenges to scaling up mHealth in South Africa. *BMC Med Inform Decis Mak* 2012;12:123.
- Organization WH. *Access to medical devices for universal health coverage and achievement of SDGs*, 2018.
- Consulting V, Berkshire U. *mHealth for development: the opportunity of mobile technology for healthcare in the developing world*, 2009.
- Babirye D, Shete PB, Farr K, *et al*. Feasibility of a short message service (SMS) intervention to deliver tuberculosis testing results in peri-urban and rural Uganda. *J Clin Tuberc Other Mycobact Dis* 2019;16:100110.
- Braun R, Catalani C, Wimbush J, *et al*. Community health workers and mobile technology: a systematic review of the literature. *PLoS One* 2013;8:e65772.
- Källander K, Tibenderana JK, Akpogheneta OJ, *et al*. Mobile health (mHealth) approaches and lessons for increased performance and retention of community health workers in low- and middle-income countries: a review. *J Med Internet Res* 2013;15:e17–e.
- Hermans SM, Elbireer S, Tibakabikoba H, *et al*. Text messaging to decrease tuberculosis treatment attrition in TB-HIV coinfection in Uganda. *Patient Prefer Adherence* 2017;11:1479–87.
- Agarwal S, Perry HB, Long L-A, *et al*. Evidence on feasibility and effective use of mHealth strategies by frontline health workers in developing countries: systematic review. *Trop Med Int Health* 2015;20:1003–14.
- Aranda-Jan CB, Mohutsiwa-Dibe N, Loukanova S. Systematic review on what works, what does not work and why of implementation of mobile health (mHealth) projects in Africa. *BMC Public Health* 2014;14:188.
- Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol* 2005;8:19–32.
- Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci* 2010;5:69.
- Institute JB. *Joanna Briggs Institute reviewers' manual*, 2015.
- Tricco AC, Lillie E, Zarin W. *PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation*, 2018: 467–73.
- Braun V, Clarke V, Hayfield N. Using thematic analysis in psychology. *Qual Res Psychol* 2006;3:77–101.
- Fabregues S, Gillian B, *et al*. *Mixed-Method appraisal methods tools MMAT_2018_criteria-manual_2018-08-01*, 2018.
- WHO. *Global diffusion of eHealth - Making universal health coverage achievable report on the third global survey on eHealth*. Geneva: World Health Organization, 2016.
- Pop-Eleches C, Thirumurthy H, Habyarimana JP, *et al*. Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: a randomized controlled trial of text message reminders. *AIDS* 2011;25:825–34.
- Moodley J, Constant D, Botha MH, *et al*. Exploring the feasibility of using mobile phones to improve the management of clients with cervical cancer precursor lesions. *BMC Womens Health* 2019;19:2.