



UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

**Digital Tools for Training Frontline Health Workers in Low- and
Middle-Income Countries: A Systematic Review**

Fransien Schoeman
(Student number: SCHFRA012)

Mini-dissertation submitted in partial fulfilment of the requirements for the
degree

MASTER OF PUBLIC HEALTH
(Social and Behavioural Sciences Specialisation)

At
UNIVERSITY OF CAPE TOWN
8 February 2019

Supervised by Dr. Alison Swartz and Dr. Amnesty LeFevre

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

Declaration

I, Fransien Schoeman, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the university to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signature:

Signed by candidate

Date: 8 February 2019

Plagiarism Declaration

This thesis/dissertation has been submitted to the Turnitin module (or equivalent similarity and originality checking software) and I confirm that my supervisor has seen my report and any concerns revealed by such have been resolved with my supervisor.

Name: Fransien Schoeman

Student number: SCHFRA012

Signature:

Signed by candidate

Date: 8 February 2019

Abstract

The World Health Organization (WHO) has forecast a global shortage of health workers by 2030, predominantly affecting low- and middle-income countries (LMICs). This sits in tension with the United Nations' (UN) Sustainable Development Goal 3 (healthy lives and well-being) through universal health coverage (UHC). To address this problem, the WHO encourages task shifting, recruitment, training, and deployment of health workers. In low- and middle-income countries (LMICs), frontline health workers (FLHWs) are responsible for expanding the reach of the health system and providing crucial reproductive, maternal, newborn and child health (RMNCH) services. Adequate and appropriate training is fundamental to the success of FLHWs, particularly in contexts where their scope of work may evolve or expand over time. Digital health solutions (defined as the use of digital, mobile and wireless technologies to support the achievement of health objectives) are increasingly being used to support the training of FLHWs. Strategies may rely on use of digital tools, including mobile phones, as the primary modality for training or as tools which augment traditional face-to-face instruction. Digital health has potential for FLHW training as it allows for listening, learning and teaching through interactive health content accessible even on basic mobile phones. This dissertation explored the literature on FLHWs in LMICs, digital health in LMICs, digital health used by FLHWs, and digital health used for training of FLHWs in LMICs. The journal "ready" component is a systematic review which discusses the various aspects of digital training for FLHWs in LMICs. For the purposes of the systematic review, seven electronic databases were searched for articles published in English from 2008-2018. Combinations of medical subheadings (MeSH) that were used were: "mHealth", "health worker", "community health worker" and "low- and middle-income country". From a total of 2628 identified studies, abstracts were screened with four filters to identify studies about "training", and eventually a total of 16 studies were included. The included studies were critically appraised and coded descriptively to enable a narrative synthesis of findings. Of the sixteen studies, twelve used mobile and/or smartphones for FLHW training. A wide range of digital platforms were used to provide information (and where relevant enable interaction). Duration of training programs varied from five days to six months. Training content was relevant to

the various health services and practice areas the FLHWs worked in. Training focused on continuing education through in-service training of new content or in-service refresher courses. Three training pedagogies were used: 1) didactic training techniques – in four studies information was provided passively without an interactive component; 2) interactive training techniques – six studies used platforms to provide information along with an interactive component via multi-media; and, 3) blended-learning approach – six studies delivered training via didactic and interactive approaches by combining live and distance training. Consistent with the literature review, all studies reported increased knowledge and positive perceptions of digital health for FLHW training. Interactive and blended learning approaches, especially when accessed through mHealth technologies, are feasible, effective, appropriate, cost effective and scalable in LMICs. The conclusion from the literature and systematic reviews were that long-term effects (e.g. change in behaviour, improved service provision) need to be researched further.

Key words: Frontline health worker, Digital health, mHealth, eHealth, Training, Low- and middle-income countries

Acknowledgements

Many thanks to Dr. Alison Swartz and Dr. Amnesty LeFevre for supervision, guidance and support.

I appreciate the contributions and input from the rest of the review team.

Thank you to friends, family and my employer for their patience, interest and understanding during my studies.

My deepest gratitude goes to my dear parents without whose constant support, unwavering dependability and cheerful encouragement this degree would not have been possible.

Contents

Declaration.....	2
Plagiarism declaration.....	3
Abstract.....	4
Acknowledgements.....	6
Part A: Protocol	
Introduction.....	11
Review questions.....	16
Main research question.....	16
Subsidiary research questions.....	16
Objective of the review.....	17
Methodology.....	17
Literature search strategy.....	17
Article inclusion and exclusion criteria.....	18
Definitions.....	19
Article selection.....	20
Data extraction.....	20
Appraisal of evidence.....	20
Data synthesis.....	21
Timeline.....	22
Study limitations.....	23
Ethical considerations.....	23

Dissemination.....23

References.....24

Part B: Literature Review

Introduction.....27

FLHWs in LMICs.....28

FLHW training.....29

Digital health in LMICs.....31

Digital tools and FLHWs in LMICs.....32

Digital health tools for FLHW training in LMICs.....34

Conclusions.....36

References.....38

Part C: Journal “ready” Manuscript

Front sheet.....44

Abstract.....45

Background.....47

Methods.....49

 Search strategy and procedure.....49

 Inclusion and exclusion criteria.....50

 Critical appraisal.....51

 Data extraction and synthesis.....51

Results.....51

 General description.....51

 Study selection.....51

Training characteristics.....	60
Training content.....	60
Training pedagogies and findings.....	60
Challenges related to implementation of digital training for FLHWs.....	62
Factors facilitating implementation of digital training programs for FLHWs.....	63
Discussion.....	63
Strengths and limitations.....	65
Conclusions.....	66
List of abbreviations.....	66
Declarations.....	67
References.....	68
 Part D: Appendices	
Appendix A: Search terms.....	73
Appendix B: Filters for abstract screening.....	101
1. FLHWs.....	101
2. Countries.....	101
3. Digital health tools.....	103
4. Tool use as defined by the WHO.....	103
Appendix C: Data extraction table.....	105
Appendix D: Table with additional information.....	106
Appendix E: Joanna Briggs Institute (JBI) Appraisal Tools.....	134
1. JBI Checklist for Randomised Controlled Trials.....	134

2. JBI Checklist for Quasi-Experimental Studies.....	139
3. JBI Checklist for Qualitative Research.....	143
4. JBI Checklist for Cross-Sectional Studies.....	146
Appendix F: Critical appraisal tables – scores.....	149
1. Quasi-experimental studies.....	149
2. Randomised controlled trials.....	150
3. Cross-sectional studies.....	151
4. Qualitative studies.....	152
Appendix G: Journal submission guidelines.....	153

Part A: Protocol

Introduction

In September 2015, as an agreement to continue progress towards the Millennium Development Goals (MDGs) set out in the year 2000, the UN General Assembly adopted the 2030 Agenda for Sustainable Development. This agenda includes 17 Sustainable Development Goals (SDGs) to be achieved by 2030, with the emphasis being the need to “ensure no one is left behind”. There is a specific health goal (SDG 3), which sets out to “ensure healthy lives and promote well-being for all at all ages” (World Health Organization, 2018a). This broad health goal calls for the achievement of universal health coverage (UHC), which is defined as access for all people and communities to services that they need without financial hardship (Stenberg et al., 2017). Stenberg et al. (2017) argue that the key to moving towards UHC lies in the adoption of principles of “progressive universalism”, i.e. ensuring equitable access to a set of key health services which increases over time, starting with the poorest. Although the SDGs concern all countries, low- and middle-income countries (LMICs) are the focus of most research and interventions around UHC and achieving the SDGs, as these countries are faced with the greatest challenges regarding increased service provision and resource mobilization (Stenberg et al., 2017).

Since the year 2000 when the MDGs were launched, the use of information and communication technologies (ICT) has brought on changes in how people go about their daily lives, including how they communicate and obtain data and information, how content is consumed and purchased, and how they do their work among many other daily practices (Novillo-Ortiz, Marin, & Saigi-Rubio, 2018). The health sector has also been impacted by changes brought about by ICT as technology enables health services to be provided in geographically inaccessible settings, facilitates provision of appropriate interventions, reduces intervention costs, and empowers health workers and patients as ICT can help with raising public awareness around management of health concerns and promoting healthy lifestyles (Novillo-Ortiz et al., 2018). Despite inequalities between LMIC

countries, the telecommunications sector has made significant advances since 2000, specifically in the areas of mobile phone subscriptions and Internet access. Wireless technologies are also said to “create opportunities to revolutionize the health sector” (p.106) (Novillo-Ortiz et al., 2018).

The World Health Organization (WHO) defines digital health as “the use of digital, mobile and wireless technologies to support the achievement of health objectives”. Digital health describes the general use of ICT for health and is inclusive of both mHealth and eHealth (World Health Organization, 2016b). Digital health is considered a transformative agent, particularly in LMICs where unprecedented penetration and ubiquity of mobile connectivity has occurred. In the past decade numerous digital health strategies have emerged not only to address long-standing health system challenges, but also working towards achieving the MDGs and SDGs (Mehl, Tamrat, Bhardwaj, Blaschke, & Labrique, 2018). However, despite implementation in many countries and numerous successes, digital health interventions seldom reach national-level scale, are seldom nationally institutionalised, and few demonstrate impact on programme or health outcomes (Mehl et al., 2018). MomConnect in South Africa is an example of the successful implementation of a digital health intervention. It is government-supported and has been nationally scaled, the coverage rates of the intervention indicate the transformative potential of digital health interventions to achieve goals that are otherwise difficult to achieve through traditional methods as pregnant women are given access to affordable, high-quality service as they need them, in accordance with the principles of UHC and the SDGs (Mehl et al., 2018).

In LMICs, FLHWs are the first, and often only, point of contact for people seeking healthcare (Walker, 2013). They work in various capacities including midwives, nurses, doctors, community health workers (CHWs), pharmacists and midwives, usually in communities where they may be from and often in remote and rural areas, connecting people and communities to the health system (Agarwal, Perry, Long, & Labrique, 2015; Frontline Health Workers Coalition, 2018; Walker, 2013). Their services and interventions are usually low-cost and cover the spectrum of community healthcare needs, e.g. teaching breast-feeding support, providing mosquito nets to prevent malaria, providing immunisations and treating common infections (Agarwal et al., 2015; Walker, 2013). They

are considered as the backbone of effective health systems and without them millions of people in LMICs will have no access to healthcare (Frontline Health Workers Coalition, 2018).

One of the main challenges of UHC is a shortage of healthcare workers in a context of global shortage of health skills (Stenberg et al., 2017). In LMICs where FLHWs are heavily relied on for healthcare, they are often not effectively trained, poorly remunerated and subsequently not retained (Redick, Dini, & Long, 2014). It is therefore important to ensure that FLHWs are well trained and equipped with the resources they need to perform their duties so that existing FLHWs are retained and the number of FLHWs is upscaled. Research has shown that training of FLHWs is inconsistent and ineffectual with infrequent or non-existent in-service training, refresher courses or disease-specific training programs, efficacy of training in terms of FLHW competency is rarely assessed, and there is a lack of cohesion across training programs (Friedman et al., 2007; Redick et al., 2014). With the rapid growth of ICT globally, digital health offers unparalleled opportunities for improvement in training as it allows the FLHW to listen, learn and teach by using interactive health content that can be accessed even on a basic mobile phone (Moore, 2015). In LMICs, frontline health workers (FLHWs) in particular can benefit from digital health interventions as the challenges they often face can be addressed, e.g. improved means of collecting data, easy access to training and reference materials, and means to communicate with supervisors and colleagues as well as patients, in order for them to adequately provide their services (Agarwal et al., 2015).

Various studies report on the ubiquity and increased connectivity via mobile communication technology specifically, since the early 2000s; e.g. mobile phone subscriptions increased globally from 2.2 billion (82 per 100 inhabitants) in 2005 to more than 7 billion (>120 per 100 inhabitants) by the end of 2015, with developing countries showing the greatest increase from 1.2 billion to over 5.5 billion mobile phone subscriptions (or nearly 92 per 100 inhabitants) in 2015 (World Health Organization, 2016a). In LMICs these subscriptions are often the only means for internet access as traditional landline connectivity does not exist or is limited, and various barriers to accessing mobile phones and the internet exist, such as high data costs, lack of network

infrastructure, digital literacy and cultural or social acceptance. It is, however, predicted that with the decrease in prices of smartphones and data, mobile internet access in developing countries will increase, which inevitably means an increase in mHealth interventions (Dalberg Global Development Advisors, 2012; World Health Organization, 2016a). Few studies report on access to and penetration of mobile phones among FLHWs specifically. Assumptions about this are made based on penetration rates of the countries studies are conducted in. According to the Dalberg report (2012), however, in some countries mobile phone access among CHWs is as high as 80%, and Mastellos et al. (2018) reported that across five districts in Malawi, mobile phone penetration rates approached 100% among FLHWs.

Along with this increase in mobile phone connectivity, the potential for support of FLHWs and thereby improving the health service they offer and the implicated improvement of health outcomes has been acknowledged by governments and public health practitioners throughout the developing world (Agarwal et al., 2016). For example, in August 2013 nearly 400 mHealth projects in 74 countries from over 100 organization were registered in the “mHealth Working Group Inventory of Projects” on the mHealthKnowledge website (Knowledge for Health, 2018), and in 2016 a review of active programs (i.e. post pilot stage) at the time, Agarwal et al. (2016) reported 131 programs that used mobile phones and tablets to support FLHWs. With regard to feasibility of the use of mHealth tools by FLHWs, Agarwal et al. (2015) found consensus in the literature and strong evidence that it was indeed a feasible context for the use of mobile technology to support health care delivery. The focus of mHealth interventions is generally on the following key functions: data collection and reporting, decision-support tools and training, emergency referrals, alerts and reminders, supervision, supply chain management, data exchange, and counselling (Agarwal et al., 2016; Batavia & Kaonga, 2014).

Even though FLHWs can include professionally qualified health practitioners such as doctors, nurses and midwives, in LMICs FLHWs are often made up of CHWs, village health workers, health extension workers and volunteers often with limited formal schooling, a low literacy level and limited training and supervision in the work that they do (Batavia & Kaonga, 2014; Dalberg Global Development Advisors, 2012). With regard to

training of FLHWs, digital training tools are looked at as a solution to improve the knowledge of existing FLHWs in order to retain them as well as educating new FLHWs in order to increase their numbers (Dalberg Global Development Advisors, 2012). In LMICs, FLHWs are increasingly being assigned additional responsibilities through task-shifting efforts, which require training and supervision – both areas where mobile technology can be leveraged to address the learning gaps as training and supervision in these situations has been poor (Batavia & Kaonga, 2014).

The use of digital applications or tools is reported as a resource-effective way to train FLHWs compared to conventional training (Dalberg Global Development Advisors, 2012), as it does not require FLHWs to leave their posts to go to a training facility, FLHWs can access the training materials at a convenient time when it does not interfere with their work tasks, accessibility to content on a mobile device costs less than buying books or training manuals (Mastellos et al., 2018), and sharing of content and information as well as communication with content providers or trainers is simple (Chipps et al., 2015). It goes without saying that the better FLHWs are trained, the more empowered they are to deliver healthcare in their community, whether it be formal (e.g. pre-service education or continuing in-service training) or informal training (e.g. on-the-job or through peer networks) (Rowe et al., 2009). In their review of best practices in the design and delivery of in-service training interventions for health workers, Bluestone et al. (2013) report that the most effective pedagogies (i.e. ways in which material is taught) are interactive, allow for repetitive exposure and self-directed learning, are on-site to “situate” learning to make the experience as similar to the workplace as possible, and use multimedia. By combining these pedagogies, which could have live instruction (e.g. face-to-face and paper-based teaching) and distance instruction (e.g. electronic text and audio) components, into a blended learning approach, the Dalberg report (2012) argues that FLHWs can be effectively, appropriately and cost-efficiently trained by using various technologies. FLHWs in LMICs use an array of digital technologies, and for training specifically, studies report the use of basic mobile phones (Chipps et al., 2015; Woods et al., 2012), smartphones (Pimmer et al., 2018), tablets (Otu et al., 2016) as well as laptop (Pimmer et al., 2018) and desktop computers (Mastellos et al., 2018).

Digital health interventions for FLHWs have been implemented around the world and especially in LMICs, however at a faster pace than the generation of evidence (Agarwal et al., 2016). Although various studies have been conducted on evaluating or describing digital or mHealth interventions and programs, the focus is broad and not concentrated on single functionalities (e.g. training or commodity tracking), e.g. evaluating the feasibility and effective use of digital tools (Agarwal et al., 2015), and how mHealth technologies support FLHWs in delivering primary healthcare services (Odendaal et al., 2015). As digital tools have a variety of functionalities, investigating each of these functionalities individually, e.g. digital tools used for training of FLHWs, will illuminate specific aspects that could be improved on, do not work at all, or can be applied to other functionalities. Rapid technological advances and increased connectivity via digital devices in LMICs enable FLHWs the opportunity to receive training that is logistically less disruptive and more accessible, and could contribute to increasing the numbers of these vital members of the health system. Therefore, given the role that digital tools can play in training of FLHWs, there is a need for an in-depth look at the characteristics of digital training tools, how they are used and to evaluate their outcomes, e.g. improvement in service provision and changes in knowledge and / or behaviour.

Review questions

Through close examination of the literature, this review seeks to assess the use of digital training tools for FLHWs in LMICs by looking at various characteristics of these tools. The review will specifically explore the following questions:

Main research question

How are digital tools used for training FLHWs in LMICs?

Subsidiary research questions

1. What types of training is done with digital tools and how are they perceived in terms of user engagement and change in knowledge and / or behaviour?
2. What are FLHWs' perceptions of the use of digital tools for training versus traditional training methods?

3. What are the key components of the programs in which digital tools are used for FLHW training? E.g. What is the geographical spread of these programs, what cadres of FLHWs are trained, what type of training was used, and what type of digital functionality was used?

Objective of the review question

The objective of this review is to investigate the digital tools that are used for training FLHWS in LMICs. The key objectives are:

1. Identify the digital tools / programs that are used for training of FLHWs in LMICs.
2. Describing FLHWs' perceptions of the digital tools.
3. Break down the components of the programs in which these digital tools are used according to geographical distribution, cadre of FLHW, types of training, and types of digital functionalities.

Methodology

Literature search strategy

A comprehensive database search will be conducted. It is widely suggested that searches in systematic reviews include a combination of databases to ensure maximum sensitivity (i.e. proportion of all studies that were retrieved by the search, also referred to as recall) and specificity (i.e. proportion of studies that were retrieved that were relevant, also referred to as precision) (Bramer, Rethlefsen, Kleijnen, & Franco, 2017; Petticrew & Roberts, 2006). The search strategy for this review, is based on those databases used in other systematic reviews on FLHWs and mHealth in LMICs, and will include the following databases: PubMed, Embase, Scopus, CINAHL, Global Health Ovid, Cochrane, and Global Index Medicus. Once relevant articles have been selected after abstract screening, the reference lists of included studies will be further hand searched, as will the reference lists of studies included for review to scan for other references that meet the inclusion criteria. The decision was made that grey literature and studies published in non-English languages would not be included due to the capacity of the review team.

The major search terms for the review will be those used by Agarwal et al. (2015) in their systematic review of digital health tools for FLWHs:

“Key search terms comprised variations and combinations of terms for mHealth [mobile, phone, cell phones, information and communication technology, cellular phone, mobile device, SMS, text message, interactive voice response (IVR)] and FLHW (frontline worker, health worker, community health worker, traditional birth attendants, lay worker, village health worker, midwife, health auxiliary peer health worker, medical auxiliary, health provider, lay advisor, lay counsellor, lady health worker and lay educator)” (p.1004) (Agarwal et al., 2015).

In addition, variations on terms for LMICs and names of these countries will be included as search terms, as defined and listed by the World Bank (World Bank 2017). MeSH terms will be sought and used as in Appendix A.

Article inclusion and exclusion criteria

Inclusion criteria for the review are:

- i) Publication dates ranging 2008 to (and including) 2018.** Given the rapid nature with which technology is changing only manuscripts published from 2008 to (and including) 2018 will be considered.
- ii) Study based in an LMIC / developing country.** As defined below.
- iii) FLHW.** As defined below.
- iv) mHealth / digital tool.** As defined below.
- v) Studies published in English.** The bias that could occur when focusing only on research published in English is acknowledged (Sterne, Egger & Moher, 2011), and this limitation is in place due to resource constraints.
- vi) mHealth tool used for training of FLHWs.** As defined below.

Exclusion criteria for the review:

The decision was made that all study designs would be included but reviews, perspective pieces, and descriptive studies would be excluded, as well as conference abstracts and poster presentations, and studies where FLHWs were not specifically defined or mentioned, studies that did not include an mHealth / digital tool, and studies that were not

set in LMICs / developing countries (all as defined below). For the purposes of this review, all studies that did not include an mHealth / digital tool used for the purposes of training FLHWs will be excluded.

Definitions

The definitions that apply to the systematic review are:

- i) FLHW:** FLHWs are comprised of all types of health workers who provide care directly to their communities, especially in remote and rural areas, and include CHWs, midwives, pharmacists, nurses and doctors, health worker, traditional birth attendants, lay worker, village health worker, health auxiliary, peer health worker, medical auxiliary, health provider, lay advisor, lay counsellor, lady health worker and lay educator (Agarwal et al., 2015; Frontline health workers coalition, 2018).
- ii) mHealth / digital tool:** mHealth refers to medical and public healthcare practices supported by mobile devices, including mobile and smart phones, patient-monitoring devices, personal digital assistants, and tablets, as well as these technologies' capabilities to create, store, retrieve, and transmit information between users, and relies on mobile phone utilities (e.g. voice, short message services (SMS), and multimedia message services (MMS)) as well as more complex applications (e.g. global positioning systems (GPS), Bluetooth technology, and third and fourth generation mobile telecommunications (3G and 4G systems)) (Odendaal et al., 2015).
- iii) LMIC:** The World Bank groups countries into four income categories based on a per capita income: low, low-middle, upper-middle and high-income (World Bank, 2017). For this review the first three categories are included under the term "low- and middle-income countries" (LMICs), which is consistent with the use of the term in the literature.
- iv) mHealth / digital training tool:** Software and platforms for training FLHWs that can be used with mobile / digital devices to work with text, images, audio, and video in the form of educational videos, informational messages, and interactive exercises that reinforce skills provided during in-person training, and also allow for continued clinical education and skills monitoring (e.g. through quizzes and case-based learning) (Labrique et al., 2013).

Article selection

Once the database searches have been completed, all the relevant study references will be imported into the computer program Covidence (Veritas Health Innovation, 2018), from where 5 reviewers will assess titles and abstracts for meeting of the inclusion criteria, as well as preliminary coding of study design (quantitative, qualitative, mixed methods, ongoing study, review) and digital health function (commodities, training of FLHW, decision support / improved quality, data capture, utilization / alerts, provider to provider communication, provider to patient communication). The reviewers will then perform full text screening of the relevant articles using four filters (FLHWs, LMICs, categories of digital tools, and categories of digital tool uses as defined by the WHO (World Health Organization, 2018b) (see Appendix B), which will then be included or excluded for data extraction. Full text screening will be recorded in a log on Microsoft Excel.

Data extraction

During full text screening all the included studies will be grouped according to the various digital health functions (i.e. commodities, training of FLHW, decision support / improved quality, data capture, utilization / alerts, provider to provider communication, provider to patient communication). For this review, only the articles that focused on training tools will be used. Data extraction will be performed using a data extraction table (see Appendix C). The extraction tables will be amended as needed during the extraction process as criteria may be included or removed once the literature has been perused.

Appraisal of evidence

Systematic reviews incorporate a process of appraisal of the research evidence. The purpose is to assess the methodological quality of the studies and to determine how bias was addressed in the design, conduct and analysis of the study (Joanna Briggs Institute, 2017). The Joanna Briggs Institute (JBI) uses appraisal checklists (Appendix D) for various study designs including randomized controlled trials (RCTs), quasi-experimental studies, qualitative research and cross-sectional studies. As this review will include all study designs, these checklists are appropriate.

Data synthesis

For this review, studies will not be excluded based on study design (i.e. included studies could be qualitative, quantitative or mixed-methods). It is anticipated that a meta-analysis will not be possible as some studies may be qualitative in nature and not include any quantitative data, and the synthesis will therefore be narrative. In order to make the study replicable, the data extraction tables will allow for review of how the narrative synthesis was done. Popay et al. (2006) suggest that the narrative synthesis process includes four elements: 1) developing a theory of how the intervention works, why and for whom, 2) developing a preliminary synthesis, 3) exploring relationships within and between studies, and 4) assessing the robustness of the synthesis. Accordingly, this review on digital training tools for FLHWs in LMICs will draw on these elements: 1) the theoretical basis of the included studies will be discussed as well as the implicit theory that underlies the use of these tools, 2) preliminary synthesis will be done using one or a combination of textual description, tabulation, grouping and clustering, transformation of the data using a common rubric, translation of the data using thematic analysis or content analysis, 3) exploring relationships within and between studies will be done by exploring the influence of heterogeneity e.g. variability in outcomes, variability in interventions, moderator variables and subgroup analyses, idea webbing and conceptual mapping, conceptual triangulation, translation as an approach to exploring relationships, qualitative case descriptions, visual representation of relationships between study characteristics and results, and / or investigator triangulation and methodological triangulation, and 4) robustness of the synthesis will be done by comparison with earlier reviews, weight of the evidence, best evidence synthesis, checking with the authors of primary studies, and / or critical reflection.

Timeline

Table 1: Timeline.

Part A: Protocol	Protocol draft (including all components, i.e. Introduction, Background, Methodology etc.)	12 November 2018
	Edits	1 December 2018
Part B: Literature review	Defining and refining search strategy	10 April 2018
	Title and abstract screening	18 May 2018
	Full text screening	12 August 2018
	Literature review draft	30 November 2018
	Edits	7 December 2018
Part C: Journal article	Data extraction	28 October 2018
	Appraisal	12 December 2018
	Synthesis	21 December 2018
	Journal article draft	12 January 2019
	Edits	28 January 2019
Intention to submit		21 January 2018
Final edit of Parts A, B and C		7 February 2019
Submission		8 February 2019
Dissemination		After the thesis has been marked and final corrections submitted, the article will be submitted to relevant journal/s for publication

Study limitations

The decision was made that grey literature and studies published in any non-English language would be excluded. The risk of publication bias by excluding grey literature is acknowledged, as is the language bias that could occur when focusing only on research published in English (Sterne, Egger & Moher, 2011), however studies have suggested that this limitation is usually not considerable (Morrison et al., 2012). To account for selection bias, abstracts of included articles will have to be reviewed and agreed upon by two reviewers and conflicts will be resolved by a third reviewer (all on Covidence). Even though a single reviewer conducts this review, a reviewer from the review team will review the included studies based on inclusion / exclusion criteria to mitigate any selection bias that may occur.

Ethical considerations

A systematic review does not involve primary research therefore no ethical review is needed as there are no ethical considerations.

Dissemination

This review fulfils the thesis component of a Master of Public Health (MPH) degree, which determines that it will be published in thesis format in the database of the University of Cape Town. A publishable manuscript version of the review will be submitted for publication to relevant journal/s in order to disseminate the findings among the academic community.

Results will be further used and incorporated with data involving various other digital health functions (e.g. decision-making, commodity tracking, provider to provider communication etc.), and disseminated accordingly.

References:

- Agarwal, S., Perry, H. B., Long, L., & Labrique, A. B. (2015). Evidence on feasibility and effective use of mHealth strategies by frontline health workers in developing countries: systematic review. *Tropical Medicine & International Health*, 20(8), 1003-1014. doi:10.1111/tmi.12525
- Agarwal, S., Rosenblum, L., Goldschmidt, T., Carras, M., Goal, N., & Labrique, A. B. (2016). *Mobile technology in support of frontline health workers: A comprehensive overview of the landscape, knowledge gaps and future directions*. Retrieved from <https://www.mhealthknowledge.org/resources/mobile-technology-support-frontline-health-workers-comprehensive-overview-landscape>:
- Batavia, H., & Kaonga, N. (2014). *mHealth support tools for improving the performance of frontline health workers: An inventory and analytical review*. Retrieved from <http://www.chwcentral.org/mhealth-support-tools-improving-performance-frontline-health-workers-inventory-and-analytical-review>
- Bramer, W. M., Rethlefsen, M. L., Kleijnen, J., & Franco, O. H. (2017). Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study. *Systematic Reviews*, 6, 245-256.
- Dalberg Global Development Advisors. (2012). *Preparing the next generation of community health workers: The power of technology for training*. Retrieved from https://3e16bo3trtw2wul252eynp6-wpengine.netdna-ssl.com/wp-content/uploads/iheedreport_2012.pdf
- Friedman, I., Ramalepe, M., Matjuis, F., Lungile Bhengu, L., Lloyd, B., Mafuleka, A., . . . Boloyi, B. (2007). *Moving towards best practice: Documenting and learning from existing community health/care worker programmes*. Retrieved from https://www.researchgate.net/publication/238080496_Moving_Towards_Best_Practice_Documenting_and_Learning_from_Existing_Community_HealthCare_Worker_Programmes
- Frontline Health Workers Coalition. (2018). Retrieved from <https://www.frontlinehealthworkers.org/who-they-are>
- Knowledge for Health. (2018). mHealthKnowledge. Retrieved from <https://www.mhealthknowledge.org/>

- Mastellos, N., Tran, T., Dharmayat, K., Cecil, E., Lee, H., Peng Wong, C. C., . . . O'Donoghue, J. M. (2018). Training community healthcare workers on the use of information and communication technologies: a randomised controlled trial of traditional versus blended learning in Malawi, Africa. *BMC Medical Education*, 18(61), 1-13. doi:<https://doi.org/10.1186/s12909-018-1175-5>
- Mehl, G. L., Tamrat, T., Bhardwaj, S., Blaschke, S., & Labrique, A. B. (2018). Digital health vision: could MomConnect provide a pragmatic starting point for achieving universal health coverage in South Africa and elsewhere? *BMJ Global Health*, 3, e000626. doi:0.1136/bmjgh-2017-000626
- Moore, C. (2015). Connecting frontline health workers to training and information. Retrieved from <https://www.frontlinehealthworkers.org/blog/connecting-frontline-health-workers-training-and-information>
- Novillo-Ortiz, D., Marin, H. F., & Saigi-Rubio, F. (2018). The role of digital health in supporting the achievement of the Sustainable Development Goals (SDGs). *International Journal of Medical Informatics*, 114, 106-107.
- Petticrew, M., & Roberts, H. (2006). How to Find the Studies: The Literature Search. In *Systematic Reviews in the Social Sciences: A Practical Guide* (pp. 79-124). Malden, MA, USA: Blackwell Publishing.
- Redick, C., Dini, H. S. F., & Long, L. (2014). *The current state of CHW training programs in Sub-Saharan Africa and South Asia: What we know, what we don't know, and what we need to do*. Retrieved from <https://www.popline.org/node/650708>
- Stenberg, K., Hanssen, O., Tan-Torres Edejer, T., Bertram, M., Brindley, C., Meshreky, A., . . . Saucat, A. (2017). Financing transformative health systems towards achievement of the health Sustainable Development Goals: a model for projected resource needs in 67 low-income and middle-income countries. *The Lancet Global Health*, 5(9), e875-e887. doi:[http://dx.doi.org/10.1016/S2214-109X\(17\)30263-2](http://dx.doi.org/10.1016/S2214-109X(17)30263-2)
- Veritas Health Innovation. (2018). Covidence. Melbourne, Australia: Veritas Health Innovation. Retrieved from www.covidence.org
- Walker, R. (2013). Walking beyond our borders with frontline health workers in Guatemala. *Nursing for Women's Health*, 17, 533-538.

- World Health Organization. (2016a). *Global diffusion of eHealth: making universal health coverage achievable. Report of the third global survey on eHealth*. Retrieved from https://www.who.int/goe/publications/global_diffusion/en/:
- World Health Organization. (2016b). *Monitoring and evaluating digital health interventions: a practical guide to conducting research and assessment*. Retrieved from <http://www.who.int/reproductivehealth/publications/mhealth/digital-health-interventions/en/>
- World Health Organization. (2018a). *Annual report on monitoring progress on UHC and the health-related SDGs*. Retrieved from <http://www.searo.who.int/mediacentre/events/governance/rc/71/sea-rc71-12.pdf?ua=1>
- World Health Organization. (2018b). *Classification of digital health interventions*. (WHO/RHR/19.06). Geneva: World Health Organization Retrieved from <https://www.who.int/reproductivehealth/publications/mhealth/classification-digital-health-interventions/en/>.

Part B: Literature Review

Introduction

In September 2015, the United Nations (UN) General Assembly adopted 17 Sustainable Development Goals (SDGs), as included in the 2030 Agenda for Sustainable Development (World Health Organization, 2018). The specific health goal (SDG 3) aims to “ensure healthy lives and promote well-being for all at all ages” through the achievement of universal health coverage (UHC) by 2030 (Stenberg et al., 2017; World Health Organization, 2018). In contrast with this goal, however, the World Health Organization (WHO) has forecast a global shortage of 18 million health workers by 2030 (Darzi & Evans, 2016; Stenberg et al., 2017). In low- and middle-income countries (LMICs), the inequity in distribution of health workers will be exacerbated by this shortage (Agarwal, Perry, Long, & Labrique, 2015). This shortage is as a result of migration of qualified health workers to richer countries, inadequate investment in national health systems, and increased workload that leads to health workers being exposed to HIV/AIDS, tuberculosis, and malaria infection, which decreases their morale (Chen et al., 2014). In LMICs, the healthcare worker shortage predominantly affects rural and remote areas (Abejirinde, Ilozumba, Marchal, Zweekhorst, & Dieleman, 2018). To address this problem, the WHO encourages task shifting, as well as recruitment, training, and deployment of health workers (Agarwal et al., 2015; O'Donovan, Kabali, et al., 2018). Task shifting allows for the transfer of responsibilities from higher-level healthcare providers to lower-level healthcare providers, effectively reducing the shortage of medical professionals in LMICs because FLHWs take on the responsibilities of providing crucial health services including prevention and treatment of illnesses and health concerns (e.g. administering immunizations, skilled birth attendance, and treatment of communicable diseases such as HIV/AIDS, tuberculosis and malaria), as well as promotion of health (e.g. promoting breastfeeding) (Agarwal et al., 2015; Todd, Mills, & Innes, 2017). In order for task shifting to be successful, FLHWs require adequate and appropriate training in the tasks that they are responsible for.

In this literature review, the role of FLHWs in LMICs will first be discussed to give context, followed by a review of the literature on training FLHWs and specifically how digital tools are used in LMICs and for training of FLHWs. In so doing gaps in the literature will be identified which the systematic review manuscript (Part C) aims to address.

FLHWs in LMICs

In LMICs, FLHWs are the first, and often only, point of contact for people seeking healthcare (Walker, 2013). They work in various capacities including midwives, nurses, doctors, community health workers (CHWs), pharmacists and midwives, usually in communities where they may be from. They are often stationed in remote and rural areas connecting people and communities to the health system (Agarwal et al., 2015; Frontline Health Workers Coalition, 2018; Walker, 2013). Their services and interventions are usually basic, low-cost, and cover the spectrum of community healthcare needs. For example, FLHWs are often involved in teaching breast-feeding support, providing mosquito nets to prevent malaria, providing immunisations and treating common infections as well as providing social services and health information to individuals and groups without access to professional healthcare (Agarwal et al., 2015; Walker, 2013). Hence, they are considered as the backbone of effective health systems and without them millions of people in LMICs will have no access to healthcare (Frontline Health Workers Coalition, 2018).

In LMICs, FLHWs face various challenges in the field, including: inadequate access to training and lack of incentives (Aranda-Jan, Mohutsiwa-Dibe, & Loukanova, 2014; Huang et al., 2018), difficulties referring patients for specialist care (Todd et al., 2017), procuring commodities (Batavia & Kaonga, 2014), lack of appropriate means to collect data (Agarwal et al., 2015; Aranda-Jan et al., 2014), limited access to professional networks (Chipps et al., 2015), poor communications with peers or supervisors (Agarwal et al., 2015; O'Donovan, Kabali, et al., 2018; The Earth Institute, 2011), unmanageable workload and difficulties arranging follow-up appointments with patients (Agarwal et al., 2015; The Earth Institute, 2011). Due to isolation and basic training, FLHW capacity is often limited to providing only the most basic care (Agarwal et al., 2015). In order to

address these barriers, numerous strategies have been developed to support FLHWs in delivering healthcare using technology, and various studies have reported evidence to support the feasibility and efficacy of some of these strategies. For the purposes of this review, the focus will be on training of FLHWs specifically using digital health tools.

FLHW training

Training is vital for FLHWs to provide the necessary healthcare services to the community in which they work, however the literature points to FLHWs often lacking adequate access to training and educational resources, and insufficient official support from government and official stakeholders (Agarwal et al., 2015; Aranda-Jan et al., 2014; Huang et al., 2018). Studies have reported the demonstrably positive effect of formal training on the performance of FLHWs and informal training plays an important role in FLHWs' knowledge base (Rowe et al., 2009). The Dalberg report (2012) on the use of technology for training of CHWs, defines formal training as training provided in three stages (i.e. pre-service training, in-service training and in-service refresher training), conducted over several hours and up to two years. Pre-service training provides baseline knowledge, theory and practice, and may be conducted by a non-government organization (NGO) or the national department of health or both. In-service training ensures competence maintenance and growth as well as additional learning in new content areas, often through a different entity than the one that provided initial training. In-service refresher training is provided periodically to ensure the FLHWs' knowledge is up to date, and usually conducted by the pre-service training entity. Informal training contributes to performance, retention and overall effectiveness, and includes peer-to-peer and on the job transfer of knowledge, as well as informal links to other medical professionals and mentors (Dalberg Global Development Advisors, 2012).

Due to the fact that FLHW training is offered by various entities, including national and local governments, NGOs and community-based organizations, they vary drastically in duration, content and methodology (Friedman et al., 2007). As a result, training can be inconsistent, ineffectual and could lead to undertraining, and this lack of cohesion across

training programs is reported to be a main contributor to many LMICs' failure to achieve goals such as the SDGs (Friedman et al., 2007; Redick, Dini, & Long, 2014).

Although FLHWs include professionally qualified health workers such as doctors, pharmacists, nurses and midwives, in LMICs they are often made up of CHWs (and the various local titles such as health extension worker, lady health visitor etc.) who also vary in level of formal schooling, skill sets, levels of training and tasks (which differ from country to country), but all trained for shorter periods of time than those trained professionally – from a few hours up to two years (Batavia & Kaonga, 2014; Dalberg Global Development Advisors, 2012). For example, in Nigeria, a Volunteer Health Worker (VHW) has no formal schooling, receives training of less than a week with an informal role in the health system, does disease surveillance, and does not receive any remuneration; whereas, a Community Health Extension Worker (CHEW) has high school education and receives accreditation and remuneration after 2 years of training, with a formal role in the health system performing immunization, case management of malaria, malnutrition etc., as well as general health promotion and counseling, similar to Accredited Social Health Activists (ASHAs) in India, who have at least eighth grade education, attend various trainings (e.g. initial induction training for 12 months as well as periodic and on-the-job training), receive accreditation and compensation for their time (Indian Association of Preventive & Social Medicine, 2018; The Earth Institute, 2011). A wide range of CHWs falls between these two extremes and provide various healthcare services, e.g. in Kenya a CHW has only high school education but with the same role and as a CHEW in Nigeria, and in Tanzania, a VHW has primary school education and performs the same tasks as a CHEW in Nigeria (Dalberg Global Development Advisors, 2012; The Earth Institute, 2011).

One of the challenges of FLHW training, especially in LMICs where FLHWs often work in hard-to-reach rural areas, is that training is held far away from the community where the FLHW works, necessitating them having to leave their posts with less than ideal consequences to the community (Mastellos et al., 2018). With the rapid growth of information and communication technologies (ICTs) globally, digital health is considered as having unparalleled opportunities for improvement in FLHW training, as it allows for

listening, learning and teaching by using interactive health content that can be accessed even on a basic mobile phone (Moore, 2015).

Digital health in LMICs

Digital health is defined as the:

“umbrella term that encompasses all concepts and activities at the intersection of health and ICTs, including mobile health (mHealth), health information technology, electronic health records (EHRs), and telehealth, and encompassing three main functions: 1) the delivery of health information, for health professionals and health consumers, through the Internet and telecommunications media, 2) using ICTs to improve public health services (e.g. through the education and training of health workers), and 3) using health information systems (HIS) to capture, store, manage or transmit information on patient health or health facility activities” (The Broadband Commission for Sustainable Development, 2017, p. 2).

According to the WHO, UHC cannot be achieved without the support of digital health as it has evident potential to facilitate the achievement of the SDGs (The Broadband Commission for Sustainable Development, 2017).

Since 2000, mobile connectivity has become ubiquitous as a result of unprecedented penetration in LMICs (Mehl, Tamrat, Bhardwaj, Blaschke, & Labrique, 2018). In LMICs these subscriptions are often the only means for internet access due to limited or nonexistent traditional landline connectivity, and various barriers to accessing mobile phones and the internet exist, such as high data costs, lack of network infrastructure, digital literacy and cultural or social acceptance. It is, however, predicted that with the decrease in prices of smartphones and data, mobile internet access in developing countries will increase, which inevitably means an increase in mHealth interventions (Dalberg Global Development Advisors, 2012; World Health Organization, 2016).

In their review of the impact of mHealth in LMICs, Hall, Fottrell, Wilkinson, and Byass (2014) report that studies showed the benefits of access to medical information – whether

through short message service (SMS) in areas with poor mobile internet access or via medical apps – through short-term learning outcome analysis, however long-term benefits to knowledge retention was not analysed. One study also showed a positive association between improved access to medical information resources via mobile technology and improved health knowledge. Hall et al. (2014) conclude that mHealth is becoming an important concept with considerable potential in LMICs, however they acknowledge that evidence of its effects on the health system are very limited (even anecdotal) due to small-scale implementation or studies at pilot level.

Two years after the Hall et al. (2014) review, Hurt, Walker, Campbell, and Egede (2016) did a similar review to determine whether mHealth interventions were effective in LMICs. Their findings are consistent with Hall et al. (2014) regarding effectiveness of mHealth strategies but also regarding the poor methodological quality of studies and the diversity in terms of sample size, sample population, intervention duration, mHealth delivery system, study design, and type of control, all of which limits replicability and generalizability. They emphasize the need for clear description of intervention components and sound methodology in future studies in order to create a baseline for the evidence to support mHealth and guide implementation in developing countries.

Although the literature in general appear optimistic about the use of digital technologies in LMICs, Chipps et al. (2015) note that perceptions about mobile learning and development seem to be “oversimplified and techno-centered” (p.2) and that a “techno-optimistic” view is often adopted in health studies that focus on small-scale studies in pilot stage because no attention is paid to socio-cultural practices and studies have limited theoretical foundation.

Digital tools and FLHWs in LMICs

Over the past decade, several reviews have been conducted to better understand FLHWs’ use of digital health in LMICs (Aamir, Ali, Boulos, Anjum, & Ishaq, 2018; Agarwal et al., 2015; Braun, Catalani, Wimbush, & Israelski, 2013; Kallander et al., 2013; Long, Pariyo, & Kallander, 2018). Few studies report on access to and penetration of mobile

phones among FLHWs specifically. Assumptions about this are made based on penetration rates of the countries studies are conducted in. Dalberg Global Development Advisors (2012), however, report that in some countries mobile phone access among CHWs is as high as 80%, and Mastellos et al. (2018) reported that in their study conducted across five districts in Malawi, mobile phone penetration rates approached 100% among FLHWs.

Goel, Bhatnagar, Sharma, and Singh (2013) reported that in LMICs, mHealth is “the only existing viable solution” to address the health worker shortage and poor accessibility to health services in rural and underserved areas. They assessed 28 projects and discussed four aspects of healthcare where mHealth resulted in “the twin benefit of reducing human resources needed for various tasks and greatly improving service quality” (p.3), i.e. data collection and disease surveillance, health education and training tool, supervision and monitoring and as a feedback mechanism. In accordance with other reviews, they report the need for projects to go beyond the pilot stage to scaling to national level, and for studies to explore further and experiment with newer applications.

In their review, Kallander et al. (2013) first performed a broad search to generate a list of domains in which mHealth was applied in LMICs. In the second stage of their review, they looked specifically at mHealth projects targeting CHWs. Interestingly the sources of information that they reviewed were primarily obtained from project websites because few peer-reviewed evaluations could be identified. This is consistent with observations throughout the literature that implementation of digital health interventions is moving at a faster pace than the generation of evidence, which means that when only peer-reviewed publications are included in reviews, it provides an incomplete picture of the range of digital health interventions being implemented to support FLHWs (Agarwal et al., 2016).

Agarwal et al. (2015) reviewed the feasibility and effective use of mHealth strategies by FLHWs in developing countries. According to them, despite various descriptive analyses of the potential of these interventions as found in pilot and small-scale studies, few studies have empirically assessed effectiveness of mHealth interventions on healthcare coverage utilization, efficiency, quality or outcomes. Like other reviews, they argue for the potential

role that mobile tools can play in supporting FLHWs in their work. Agarwal et al. (2015) discuss the role that mobile tools can play in improving FLHWs' motivation, self-efficacy and enthusiasm for their work which subsequently contribute to FLHW retention. Based on these observations, they propose a framework that illustrates how mHealth functions may support FLHWs across their professional lifespan under the domains of training (how mHealth strategies are used to prepare FLHWs for their jobs), provision of care (how mHealth strategies can help FLHWs in performing their tasks) and retention (how mHealth strategies can aid in motivation and retention of FLHWs).

In a recent review, Long et al. (2018) consider digital health as an opportunity for LMICs to train, motivate, support, monitor, and pay health workers as it has the ability to reach all cadres of FLHWs and those who work in hard-to-reach areas that are routinely underrepresented in human resources for health (HRH) information systems. They argue that the reason for the slow rate of scaling digital health at national level is due to the research community's struggle to create an evidence base for decision makers to confidently expand digital health beyond the pilot stage to a provincial or national level. They propose that an implementation research perspective (involving an iteration of learning by doing, analysis and selection of the most promising approaches) will help with answering critical questions. They caution against a 'more of the same' approach as this will result in a continued lack of evidence with the risk of not leveraging the potential capabilities that digital technologies can contribute to the health sector.

Digital health tools for FLHW training in LMICs

According to the Dalberg report (2012), for training of FLHWs in particular, digital health is reported as effective, appropriate, highly cost efficient, and scalable, especially if it is used in a blended learning approach. In their report on the use of technology for training of CHWs, they discuss various training pedagogies for CHWs, and specifically two traditional education techniques: 1) didactic techniques, i.e. passive educational experience which includes lectures or reading; and 2) interactive techniques, i.e. active educational experience that allows interaction and dialogue between the learner and facilitator and includes simulations, role play, or case-based learning. They further

discuss timing (one time or repetitive), location (offsite or onsite), and teaching modes (live through paper-based, electronic-based with no animation, and multimedia-based or distance learning). In their review of best practices in the design and delivery of in-service training interventions for health workers, Bluestone et al. (2013) report that the most effective pedagogies (i.e. ways in which material is taught) are: 1) interactive rather than passive, 2) allow for repetitive exposure rather than single-event frequency, 3) encourages self-directed learning rather than dictated pace, time and content, 4) are on-site to “situate” learning to make the experience as similar to the workplace as possible rather than clinical settings with no similarities to the workplace, and 5) use multimedia rather than a single medium to deliver the curriculum. By combining these pedagogies, which could have live instruction (e.g. face-to-face and paper-based teaching) and distance instruction (e.g. electronic text and audio) components, into a blended learning approach, Dalberg Global Development Advisors (2012) argue that CHWs can be effectively, appropriately and cost-efficiently trained by using various technologies. In LMICs, FLHWs use an array of digital technologies, and for training specifically, studies report the use of basic mobile phones (Chipps et al., 2015; Woods et al., 2012), smartphones (Pimmer et al., 2018), tablets (Otu et al., 2016) as well as laptop (Pimmer et al., 2018) and desktop computers (Mastellos et al., 2018).

In their review of ongoing training of CHWs in LMICs, O'Donovan, O'Donovan, Kuhn, Sachs, and Winters (2018) found that mobile technology was used less frequently than expected especially considering the use of digital health in training other cadres of health professionals (O'Donovan, Bersin, & O'Donovan, 2014). They also found the infrequent use of digital training tools in sub-Saharan countries surprising given the high ownership of mobile phones in the region, and therefore suggested that the use of mHealth to facilitate ongoing training warrants further research. They emphasized the need for participation of FLHWs in the design and implementation of digital training through participatory action research as this promotes autonomy and social justice by working on the principle that end-users' wishes and needs have to be respected and valued. Also, sociocultural sensitivities and the financial implications of considering mobile technologies for FLHW training need to be considered so as not to reinforce existing

socioeconomic, geographical and gender inequalities. Consistent with Hurt et al. (2016), O'Donovan, O'Donovan, et al. (2018) comment on the variability between digital training programs in terms of design, structure, duration etc. which means that little is understood about how best to deliver ongoing training. They suggest that future research considers training as a complex intervention as opposed to focusing on specific practice areas (e.g. child and maternal health or nutrition), in limited geographic contexts and measuring and reporting outcomes by using variable approaches. By evaluating digital training as such, better sense can be made of the complex nature of training to understand “what works, for whom and under what conditions” (p. 8), and therefore by considering the contextual requirements, it is more likely that ongoing training programs will contribute to improvement on a systems level in resource limited settings such as LMICs.

Todd et al. (2017) report that even though reviews on interventions describe improved health service provider performance as a result of digital training, there is a need for greater standardization of provider support, especially following in-service training with supportive supervision and mentoring.

Conclusions

The reviews that were included in this literature review had consistent findings regarding the potential of digital health for use by FLHWs in LMICs. Although results suggested usefulness, effectiveness and cost-effectiveness of digital health interventions, all reviews emphasized the need for programs to be implemented beyond pilot stage and for long-term evaluations to determine the real effects of these interventions on their intended populations. Some studies highlighted the need for FLHWs to be included in the development and implementation of digital health interventions to ensure that sociocultural factors are taken into account and for interventions to be appropriate in the community where it is implemented.

The studies and reviews that were included in this literature review evaluated or described digital interventions and programs, however the focus is broad and not concentrated on single functionalities like training or commodity tracking, e.g. evaluating the feasibility and

effective use of digital tools (Agarwal et al., 2015), and how mHealth technologies support FLHWs in delivering primary healthcare services (Odendaal et al., 2015). Some studies reported that evidence of the use of digital health for training and educational purposes is scarce (Chipps et al., 2015; Kenny, Heavin, O'Connor, & Ndibuagu, 2017; Winters, Oliver, & Langer, 2017). In their review, Hurt et al. (2016) note that replicability and generalizability of studies is limited by the diversity of variables such as sample size, sample population, intervention duration etc., and that clear description of intervention components and sound methodology is needed in future studies in order to create a baseline for the evidence to support mHealth and guide implementation in LMICs.

In the light of WHO's predicted shortage of healthcare workers, producing and maintaining an adequate number of health workers is not the only challenge to be faced. The misalignment between health system needs and education and training of the health workforce needs to be addressed (Pálsdóttir et al., 2016). Investing in the health workforce in LMICs, specifically in training of health workers, not only shows improvements in health but also socioeconomically (Bluestone et al., 2013; Pálsdóttir et al., 2016). The fast rate of access to and adoption of technology in LMICs, specifically mobile technology, present opportunities to deliver FLHW training in various new ways, however there is a need for further research into the combinations of technique, setting, frequency and media used in training for it to be effective, cost-effective and culturally appropriate (Bluestone et al., 2013).

Therefore, the aim of the systematic review (Part C) is to consider digital training of FLHWs as a complex intervention (O'Donovan, O'Donovan, et al., 2018), and discussing the various components of training programs (i.e. mobile device and platform used, cadre of FLHW, type of training etc.). Based on the findings from the literature, suggestions will be made on how future training programs could be developed, structured and implemented to ensure feasible, appropriate and effective FLHW training through digital health.

References:

- Aamir, J., Ali, S. M., Boulos, M. N. K., Anjum, N., & Ishaq, M. (2018). Enablers and inhibitors: A review of the situation regarding mHealth adoption in low- and middle-income countries. *Health Policy and Technology*, 7, 88-97.
- Abejirinde, I. O., Ilozumba, O., Marchal, B., Zweekhorst, M., & Dieleman, M. (2018). Mobile health and the performance of maternal health care workers in low- and middle-income countries: A realist review. *International Journal of Care Coordination*, 21(3), 73-86. doi:10.1177/2053434518779491
- Agarwal, S., Perry, H. B., Long, L., & Labrique, A. B. (2015). Evidence on feasibility and effective use of mHealth strategies by frontline health workers in developing countries: systematic review. *Tropical Medicine & International Health*, 20(8), 1003-1014. doi:10.1111/tmi.12525
- Agarwal, S., Rosenblum, L., Goldschmidt, T., Carras, M., Goal, N., & Labrique, A. B. (2016). *Mobile technology in support of frontline health workers: A comprehensive overview of the landscape, knowledge gaps and future directions*. Retrieved from <https://www.mhealthknowledge.org/resources/mobile-technology-support-frontline-health-workers-comprehensive-overview-landscape>:
- Aranda-Jan, C. B., Mohutsiwa-Dibe, N., & Loukanova, S. (2014). Systematic review on what works, what does not work and why of implementation of mobile health (mHealth) projects in Africa. *BMC Public Health*, 14(188), 1-15.
- Batavia, H., & Kaonga, N. (2014). *mHealth support tools for improving the performance of frontline health workers: An inventory and analytical review*. Retrieved from <http://www.chwcentral.org/mhealth-support-tools-improving-performance-frontline-health-workers-inventory-and-analytical-review>
- Bluestone, J., Johnson, P., Fullerton, J., Carr, C., Alderman, J., & BonTempo, J. (2013). Effective in-service training design and delivery: evidence from an integrative

- literature review. *Human Resources for Health*, 11(51), 1-26. doi:10.1186/1478-4491-11-51
- Braun, R., Catalani, C., Wimbush, J., & Israelski, D. (2013). Community health workers and mobile technology: A systematic review of the literature. *PLoS ONE*, 8(6), e65772. doi:10.1371/journal.pone.0065772
- Chen, Y., Yang, K., Jing, T., Tian, J., Shen, X., Xie, C., . . . Cao, X. (2014). Use of text messages to communicate clinical recommendations to health workers in rural China: a cluster-randomized trial. *Bulletin of the World Health Organization*, 92, 474-481. doi:10.1007/s12553-013-0073-4
- Chippis, J., Pimmer, C., Brysiewicz, P., Walters, F., Linxen, S., Ndebele, T., & Gröhbiel, U. (2015). Using mobile phones and social media to facilitate education and support for rural-based midwives in South Africa. *Curationis*, 38(2), 8. doi:<http://dx.doi.org/10.4102/curationis.v38i2.1500>
- Dalberg Global Development Advisors. (2012). *Preparing the next generation of community health workers: The power of technology for training*. Retrieved from https://3e16bo3trtw2wul252eynp6-wpengine.netdna-ssl.com/wp-content/uploads/iheedreport_2012.pdf
- Darzi, A., & Evans, T. (2016). The global shortage of health workers - an opportunity to transform care. *The Lancet*, 388, 2576-2577.
- Friedman, I., Ramalepe, M., Matjuis, F., Lungile Bhengu, L., Lloyd, B., Mafuleka, A., . . . Boloyi, B. (2007). *Moving towards best practice: Documenting and learning from existing community health/care worker programmes*. Retrieved from https://www.researchgate.net/publication/238080496_Moving_Towards_Best_Practice_Documenting_and_Learning_from_Existing_Community_HealthCare_Worker_Programmes

Frontline Health Workers Coalition. (2018). Retrieved from <https://www.frontlinehealthworkers.org/who-they-are>

Goel, S., Bhatnagar, N., Sharma, D., & Singh, A. (2013). Bridging the human resource gap in primary health care delivery systems of developing countries with mHealth: Narrative literature review. *JMIR mHealth and uHealth*, 1(2), e25. doi:10.2196/mhealth.2688: 10.2196/mhealth.2688

Hall, C. S., Fottrell, E., Wilkinson, S., & Byass, P. (2014). Assessing the impact of mHealth interventions in low- and middle-income countries - what has been shown to work?2014. *Global Health Action*, 7, 25606. doi:10.3402/gha.v7.25606

Huang, W., Long, H., Li, J., Tao, S., Zheng, P., Tang, S., & Abdullah, A. S. (2018). Delivery of public health services by community health workers (CHWs) in primary health care settings in China: a systematic review (1996-2016). *Global Health Research and Policy*, 3(18), 1-29. doi:10.1186/s41256-018-0072-0

Hurt, K., Walker, R. J., Campbell, J. A., & Egede, L. E. (2016). mHealth interventions in low- and middle-income countries: A systematic review. *Global Journal of Health Science*, 8(9), 183-193.

Indian Association of Preventive & Social Medicine. (2018). *Guidelines on Accredited Social Health Activists (ASHA)*. Retrieved from http://www.iapsmgc.org/userfiles/16ASHA_guidelines.pdf.

Kallander, K., Tibenderana, J. K., Akpogheneta, O. J., Strachan, D., Hill, Z., Ten Asbroek, A. H. A., . . . Meek, S. R. (2013). Mobile health (mHealth) approaches and lessons for increased performance and retention of community health workers in low- and middle-income countries: A review. *Journal of Medical Internet Research*, 15(1), e17. doi:10.2196/jmir.2130: 10.2196/jmir.2130

- Kenny, G., Heavin, C., O'Connor, Y., & Ndibuagu, E. (2017). *Bridging the knowledge gap: Towards a comprehensive mHealth training framework*. Paper presented at the 25th European Conference on Information Systems (ECIS), Guimarães, Portugal.
- Long, L., Pariyo, G., & Kallander, K. (2018). Digital technologies for health workforce development in low- and middle-income countries: A scoping review. *Global Health: Science and Practice*, 6(Supplement 1), S41-48.
- Mastellos, N., Tran, T., Dharmayat, K., Cecil, E., Lee, H., Peng Wong, C. C., . . . O'Donoghue, J. M. (2018). Training community healthcare workers on the use of information and communication technologies: a randomised controlled trial of traditional versus blended learning in Malawi, Africa. *BMC Medical Education*, 18(61), 1-13. doi:<https://doi.org/10.1186/s12909-018-1175-5>
- Mehl, G. L., Tamrat, T., Bhardwaj, S., Blaschke, S., & Labrique, A. B. (2018). Digital health vision: could MomConnect provide a pragmatic starting point for achieving universal health coverage in South Africa and elsewhere? *BMJ Global Health*, 3, e000626. doi:0.1136/bmjgh-2017-000626
- Moore, C. (2015). Connecting frontline health workers to training and information. Retrieved from <https://www.frontlinehealthworkers.org/blog/connecting-frontline-health-workers-training-and-information>
- O'Donovan, J., Bersin, A., & O'Donovan, C. (2014). The effectiveness of mobile health (mHealth) technologies to train healthcare professionals in developing countries: a review of the literature. *BMJ Innovations*, 1, 33-36. doi:10.1136/bmjinnov-2014-000013
- O'Donovan, J., Kabali, K., Taylor, C., Chukhina, M., Kading, J. C., Fuld, J., & O'Neil, E. (2018). The use of low-cost Android tablets to train community health workers in Mukuno, Uganda, in the recognition, treatment and prevention of pneumonia in children under five: a pilot randomised controlled trial. *Human Resources for Health*, 16(49), 1-9. doi:10.1186/s12960-018-0315-7

- O'Donovan, J., O'Donovan, C., Kuhn, I., Sachs, S. E., & Winters, N. (2018). Ongoing training of community health workers in low-income and middle-income countries: a systematic scoping review of the literature. *BMJ Open*, 8, e021467. doi:10.1136/bmjopen-2017-021467
- Pálsdóttir, B., Barry, J., Bruno, A., Barr, H., Clithero, A., Cobb, N., . . . Worley, P. (2016). Training for impact: the socio-economic impact of a fit for purpose health workforce on communities. *Human Resources for Health*, 14(49), 1-9.
- Redick, C., Dini, H. S. F., & Long, L. (2014). *The current state of CHW training programs in Sub-Saharan Africa and South Asia: What we know, what we don't know, and what we need to do*. Retrieved from <https://www.popline.org/node/650708>
- Rowe, A. K., Rowe, S. Y., Vujicic, M., Ross-Degnan, D., Chalker, J., Holloway, K. A., & Peters, D. H. (2009). Chapter 3: Review of strategies to improve health care provider performance. In D. H. Peters, S. El-Saharty, B. Siadat, K. Janovsky, & M. Vujicic (Eds.), *Improving Health Service Delivery in Developing Countries* (pp. 101-117). Washington, DC: The World Bank.
- Stenberg, K., Hanssen, O., Tan-Torres Edejer, T., Bertram, M., Brindley, C., Meshreky, A., . . . Saucat, A. (2017). Financing transformative health systems towards achievement of the health Sustainable Development Goals: a model for projected resource needs in 67 low-income and middle-income countries. *The Lancet Global Health*, 5(9), e875-e887. doi:[http://dx.doi.org/10.1016/S2214-109X\(17\)30263-2](http://dx.doi.org/10.1016/S2214-109X(17)30263-2)
- The Broadband Commission for Sustainable Development. (2017). *Digital Health: A Call for Government Leadership and Cooperation between ICT and Health*. Retrieved from <https://www.broadbandcommission.org/Pages/default.aspx>
- The Earth Institute. (2011). *One Million Community Health Workers: Technical Task Force Report*. Retrieved from <http://www.chwcentral.org/one-million-community-health-workers-technical-task-force-report>

Todd, C. S., Mills, S. J., & Innes, A. L. (2017). Electronic health, telemedicine, and new paradigms for training and care. *Current Opinion in HIV and AIDS*, 12(5), 475-487. doi:10.1097/COH.0000000000000402

Walker, R. (2013). Walking beyond our borders with frontline health workers in Guatemala. *Nursing for Women's Health*, 17, 533-538.

Winters, N., Oliver, M., & Langer, L. (2017). Can mobile health training meet the challenge of 'measuring better'? *Comparative Education*, 53(1), 115-131. doi:10.1080/03050068.2017.1254983

World Health Organization. (2016). *Global diffusion of eHealth: making universal health coverage achievable. Report of the third global survey on eHealth*. Retrieved from https://www.who.int/goe/publications/global_diffusion/en/:

World Health Organization. (2018). *Annual report on monitoring progress on UHC and the health-related SDGs*. Retrieved from <http://www.searo.who.int/mediacentre/events/governance/rc/71/sea-rc71-12.pdf?ua=1>

Part C: Journal “ready” Manuscript

This article has been prepared for submission to *Human Resources for Health*. Author instructions are available online (<https://human-resources-health.biomedcentral.com/submission-guidelines/preparing-your-manuscript/review>) as well as in Part D: Supplementary Material (Appendix G).

Title page (as prescribed by the journal)

- **Title:** Digital tools for training frontline health workers in low- and middle-income countries: A systematic review
- **Author:** Fransien Schoeman
University of Cape Town
Email address: fransien.schoeman@gmail.com
- **Corresponding author:** Fransien Schoeman

Digital tools for training frontline health workers in low- and middle-income countries: A systematic review

Abstract

Background: In low- and middle-income countries (LMICs), frontline health workers (FLHWs) are responsible for expanding the reach of the health system and providing crucial reproductive, maternal, newborn and child health (RMNCH) services. Adequate and appropriate training is fundamental to the success of FLHWs, particularly in contexts where their scope of work may evolve or expand over time. Digital health solutions are increasingly being used to support the training of FLHWs. Strategies may rely on use of digital tools, including mobile phones, as the primary modality for training or as tools which augment traditional face-to-face instruction. This review synthesizes evidence on the use of digital tools for training FLHWs in LMICs.

Methods: Seven electronic databases were searched for articles published in English from 2008-2018. Combinations of medical subheading (MeSH) that were used were: “mHealth”, “health worker”, “community health worker” and “low- and middle-income country”. From a total of 2628 identified studies, 1205 duplicates were removed, 1423 abstract were screened using 4 filters (FLHW, LMIC, 15 digital tool categories, and 7 categories of digital tool uses). From there 452 articles were assessed for eligibility, of which 294 were excluded for not meeting the inclusion criteria. 158 articles met the inclusion criteria and fell in the 7 categories of digital tool use, and included for full-text screening. 15 of those articles were concerned with training, and therefore included in this review. Reference lists of the 15 studies identified for inclusion were searched which led to the inclusion of one additional study bringing the total up to 16 included studies. The included studies were critically appraised and coded descriptively to enable a narrative synthesis of findings.

Results: Of the sixteen studies, twelve used mobile and/or smartphones for FLHW training. A wide range of digital platforms were used to provide information (and where relevant enable interaction). Duration of training programs varied from five days to six months. Training content was relevant to the various health services and practice areas the FLHWs worked in. Training focused on continuing education through in-

service training of new content or in-service refresher courses. Three training pedagogies were used: 1) didactic training techniques – four studies provided information passively through the digital device; 2) interactive training techniques – six studies used platforms to provide information along with an interactive component via multi-media; and, 3) blended-learning approach – six studies delivered training via didactic and interactive approaches by combining live and distance training.

Conclusions: All studies reported increased knowledge and positive perceptions of digital health for FLHW training. Interactive and blended learning approaches, especially when accessed through mHealth technologies, are feasible, effective, appropriate, cost effective and scalable in LMICs. However, long-term effects (e.g. change in behaviour, improved service provision) need to be researched further.

Key words: Frontline health worker, Digital health, mHealth, eHealth, Training, Low- and middle-income countries

Background

The World Health Organization (WHO) has forecast a global shortage of 18 million health workers by 2030, predominantly affecting low- and middle-income countries (LMICs) [1-3]. This shortage sits in tension with the United Nations' (UN) Sustainable Development Goals (SDGs), specifically SDG3 which aims to “ensure healthy lives and promote well-being for all at all ages” through universal health coverage (UHC) [2, 4, 5]. To address this problem, the WHO encourages task shifting, recruitment, training, and deployment of health workers [6, 7]. Through task shifting, frontline health workers (FLHWs) provide crucial health services, effectively reducing the shortage of medical professionals in LMICs while expanding the reach and scope of services available [6, 8].

The training FLHWs receive plays a fundamental role in determining the content and quality of services provided, and more broadly the success of task shifting efforts. In LMICs traditional face-to-face methods may not be feasible given the cost and resource implications, volume of FLHWs, and their geographic location often in hard to reach rural areas [8]. FLHWs typically work in their resident communities and are often the communities' only link with the health system [6]. Although FLHWs may include professionally qualified health workers including midwives, in LMICs they are often community health workers (CHWs) with various local titles, varying in level of formal schooling, skill sets, levels of training and tasks, but all trained for shorter periods of time than those trained professionally – from a few hours up to two years [9, 10]. Through task shifting, FLHWs often have to perform tasks above their training level, therefore necessitating means of supporting them by providing continued training, up-to-date information and guidelines to ensure improved service delivery [6, 11].

Traditional training often requires FLHWs to travel to cities to attend training or refresher courses, thus leaving their communities for the duration of the course, potentially at a cost in the community's welfare [12]. However, with rapid global growth of information and communication technologies (ICTs) and unprecedented penetration and ubiquity of mobile connectivity in LMICs, digital health (i.e. the use of digital, mobile and wireless technologies for health, including electronic and mobile health

(eHealth and Health)) presents unparalleled opportunities for FLHW training as it allows for listening, learning and teaching using interactive health content accessible even on a basic mobile phone [13, 14].

The Dalberg report on the use of technology for training of CHWs [10] discusses conventional educational training pedagogies: didactic teaching techniques, using passive educational experience based on lectures or readings; and, interactive teaching techniques, where learners and facilitators engage in interactive dialogues, role play and/or case-based learning. Their suggestion, however is for a blended learning approach, where training is anchored to live, in-person training but incorporates multimedia technology remotely or in a classroom setup. Bluestone et al. [15] summarise the most effective pedagogies for FLHW training as: interactive, allowing for repetitive exposure, encouraging self-directed learning, on-site to “situate” learning to make experiences as similar to the workplace as possible, and using multimedia to deliver the curriculum. A blended learning approach therefore combines these pedagogies (refer to Figure 1 below), and FLHWs can be effectively, appropriately and cost-efficiently trained by using various technologies [10].

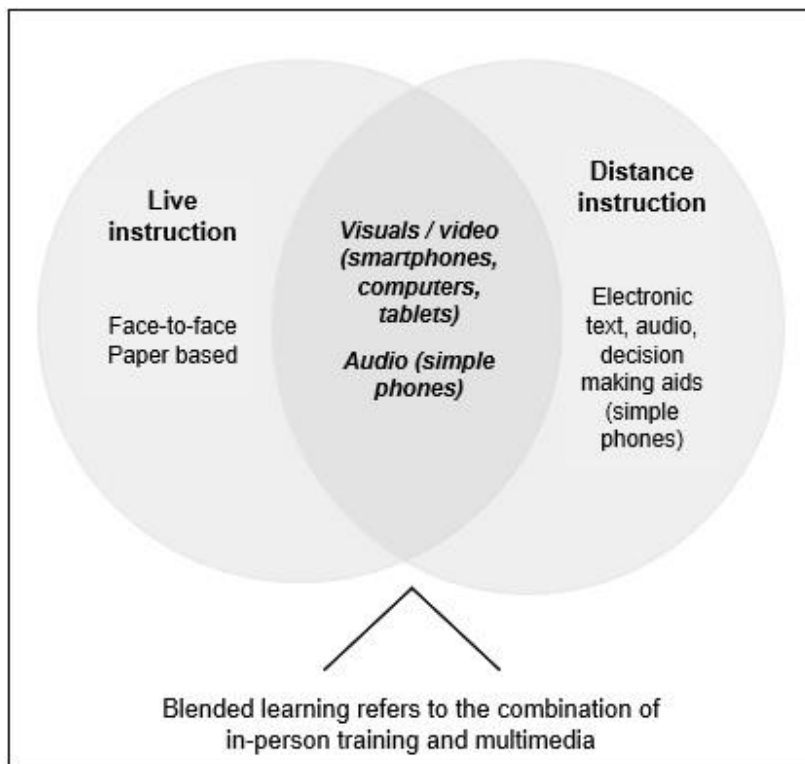


Figure 1 Blended learning [10]

As the field of digital health emerged over the last two decades, research has been conducted on the feasibility, usability, and impact of technology on health across context and users groups, and for various purposes [11]. The focus of these studies tended to be general rather than concentrated on single digital functionalities (like training or commodity tracking), e.g. evaluating feasibility and effective use of digital tools [6], and how mHealth technologies support FLHWs in delivering primary healthcare services [16]. Investigating each type of digital tool functionality, e.g. those used for training of FLHWs, could point to aspects for improvement, those that do not work, or can be applied to other functionalities. Rapid technological advances and increased connectivity via digital devices in LMICs enable less disruptive and more accessible FLHW training, which could increase FLHW numbers in LMIC health systems [10].

Given the potential of digital health in training of FLHWs in LMICs, the aim of this review was to explore the characteristics, use and related outcomes (e.g. FLHW perceptions or changes in knowledge) of digital tools for FLHW training in LMICs. Review findings were then used to make recommendations for the development, structure and implementation of future training programs to ensure their feasibility, appropriateness and effectiveness in training FLHW through digital health.

Methods

Search strategy and procedure

At first, from April to May 2018, a broad search for all manuscripts published in English focused on digital tools, LMICs and FLWHs was conducted. The following databases were searched: PubMed, Embase, Scopus, CINAHL, Global Health Ovid, Cochrane, and Global Index Medicus. Medical subject headings (MeSH) combinations were used for: “mHealth”, “health worker”, “community health worker” and “low- and middle-income country” (see Appendix A). Given the rapid nature with which technology is changing only manuscripts published from 2008 to (and including) 2018 were considered. In addition, all reference lists of included full text articles, related systematic reviews and publication lists of known and published authors working in the field of digital tools and FLWHs in LMICs were checked for additional articles for inclusion. Following database searches, all relevant abstracts were imported into

Covidence (software program). Titles and abstracts were reviewed for inclusion by a group of five reviewers using four filters (FLHW, LMIC, 15 categories of digital tools, and 7 categories of digital tool use as defined by the WHO [17]; see Appendix B). At this stage, articles were given a preliminary code linked to study design (quantitative, qualitative, mixed methods, ongoing study, review) and digital tool use (training, commodities, decision support / improved quality, data capture, utilization / alerts, provider to provider communications, provider to patient communication). Eight reviewers then performed full text screening of relevant articles and recorded in a log on Microsoft Excel, which were then included or excluded for data extraction.

Inclusion and exclusion criteria

The inclusion criteria for articles were:

1. *Participants*: FLHWs provide care directly to their communities, especially in remote and rural areas, and include all types of healthworkers, e.g. CHWs, midwives, pharmacists, nurses and doctors, health worker, traditional birth attendants, lay worker, village health worker, health auxiliary, peer health worker, medical auxiliary, health provider, lay advisor, lay counsellor, lady health worker and lay educator [6, 18].
2. *Intervention*: Digital health training encompasses all concepts and activities at the intersection of health and ICTs, including mobile health (mHealth) and electronic health (eHealth), in the delivery of health information for health professionals and health consumers, through the Internet and telecommunications media, to improve public health services (e.g. through training health workers) [19, 20]. Training can be conducted via text, images, audio, and video in the form of educational videos, informational messages, and interactive exercises that reinforce skills provided during in-person training, and also allow for continued clinical education and skills monitoring (e.g. through quizzes and case-based learning) [21].
3. *Comparison*: Not applicable.
4. *Outcome*: Delivery of reported intervention.

5. *Study types*: All study designs were included, and studies conducted in LMICs focused on various public health services (see Table 1 for health services and practice areas).

The exclusion criteria included: i) articles published in non-English languages; 1) articles that did not include or specifically mention FLHWs; 2) studies that did not include a digital health tool; 3) studies that were not conducted in LMICs; 4) grey literature; 5) reviews, perspective pieces, descriptive studies, conference abstracts and poster presentations.

Critical appraisal

The Joanna Briggs Institute (JBI) checklists were used for assessment of evidence quality and how bias was controlled in each study. These checklists allow for assessment according to study design [22]. This is a mixed-methods review including randomised controlled trials (RCTs), quasi-experimental, qualitative and cross-sectional studies. Detail of the appraisal according to study design as well as appraisal scores are seen in Appendices C and D, and appraisal scores are also included in the summary table (Table 1).

Data extraction and synthesis

A data extraction tool was designed to capture relevant information from each included study in an Excel spreadsheet (see Appendix C). Because this review included a number of different study designs, a quantitative synthesis could not be done. Instead, a narrative synthesis was most appropriate to explore the various aspects of digital training tools.

Results

General description

Study selection

Database search identified a total of 2628 abstracts, of which 1205 were duplicates. Titles and abstracts of 1423 records were screened using the 4 screening filters, and 971 were excluded for not including FLHW, LMIC or a digital tool. Of the 452 full text articles that were reviewed, 294 were excluded for not meeting eligibility criteria. A

total of 158 articles focused on one or more of 7 key digital health domains identified by WHO [17] and modified for FLHWs: Data capture (n=60, 38%), decision support (35, 22%), provider to provider communication (24, 15%); training (15, 9%); provider to patient communication (14, 9%); alerts, reminders, health information content (9, 6%); and commodity tracking (1, 1%). This review focused on training tools for FLHWs and thus the 15 articles identified. One additional article was located through hand search of reference lists; bringing the total to 16 articles included in this review (see Figure 1 PRISMA flow diagram for screening process).

The 16 included studies are summarized by study design in Table 1, including 6 quasi-experimental studies, 4 randomized controlled trials (RCTs), 4 cross-sectional studies and 2 qualitative studies. Evaluation activities spanned across three focus areas: 1) studies describing development of intervention programs [23] and usage of digital platforms [7, 24]; 2) studies that assessed acceptability [7, 24, 25], feasibility [7, 26, 27], and effectiveness [7, 12, 23, 27-34]; and 3) studies that explored FLHW perceptions [24, 35], satisfaction [12, 33], and the psychological impact and mechanisms of digital training [36]. All studies reported facilitating factors, successes, challenges and limitations, except one which [36] did not report challenges or limitations.

Table 1 includes information about the geographic location where the program was implemented, cadre/s of FLHW, sample size of the evaluation, disease / practice area & health service of FLHWs, language used in the training program, and duration of training, all of which are not further discussed due to the word limitation. Also, see Appendix D for additional information. The training characteristics of digital health interventions are discussed in depth.

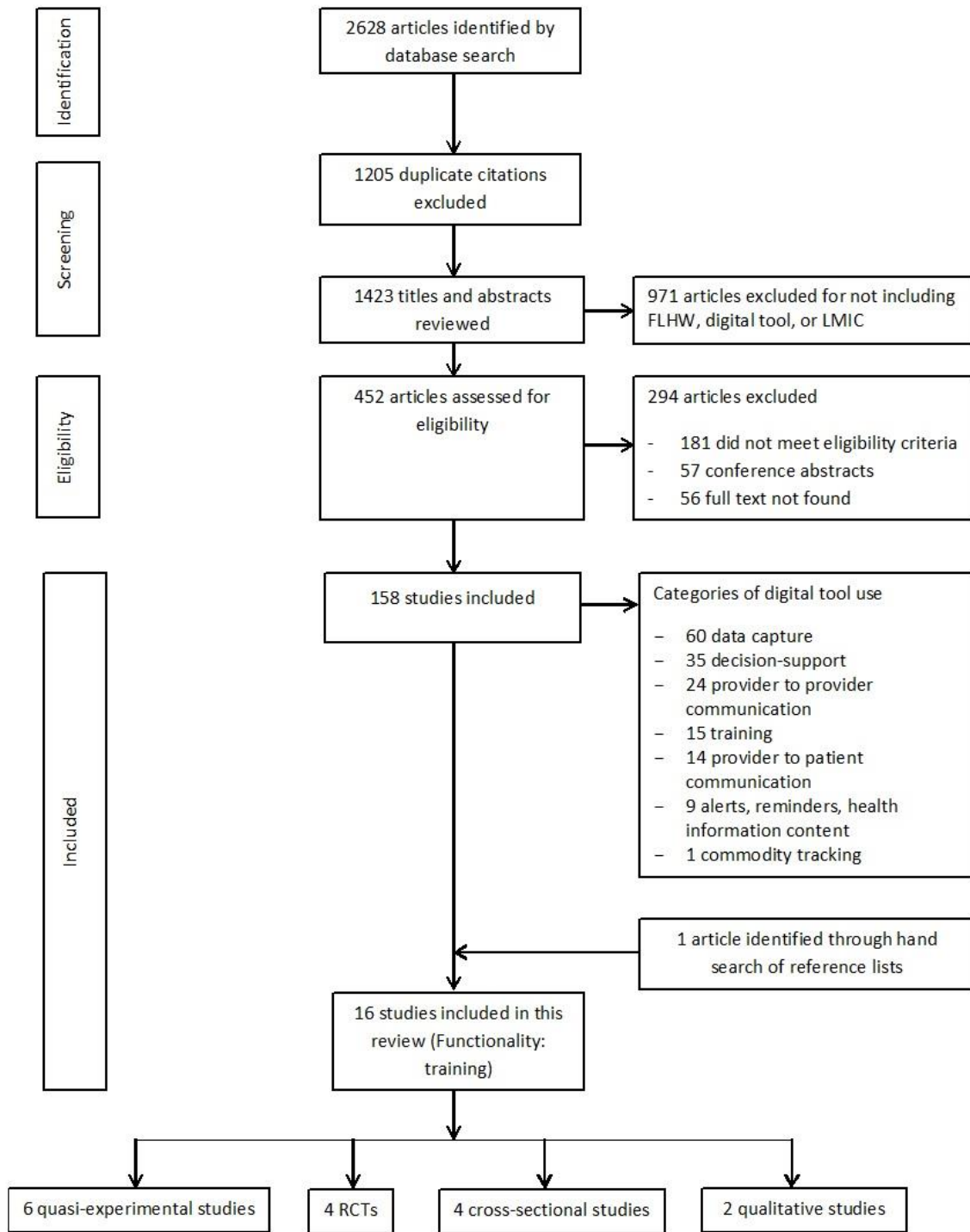


Figure 1 PRISMA flow diagram

Table 1 Summary of included articles by study design

Author	Year	Location	Cadre of FLHW	Sample size of evaluation	Disease / practice area & health service	Digital device & platform	Language	Duration of training	Appraisal score
<i>Quasi-experimental studies: (n=6)</i>									
Diedhiou et al. [26]*	2015	Mékhé and Tivaouane cities, Senegal	Nurses and midwives	n=20	Family planning; contraceptive side effects and misconceptions	Mobile phone; interactive voice response (IVR) mLearning training system	Training course packet in English and French; audio questions and explanations recorded in French.	Majority completed course in 5 weeks; 1 participant required 9 weeks. 17 Multiple choice questions and 3 true/false questions along with accompanying detailed explanations spaced and repeated over time; 0-4 questions per day. Process done over 2 rounds.	6/9
Limaye et al. [30]*	2015	2 districts in Bangladesh	Family Welfare Assistants (FWA) and Health Assistants (HA)	n=±300	Management of health, population and nutrition knowledge	Netbook computers; eToolkit and eLearning courses	Local language	Not reported	3/9
Otu et al. [31]	2015	Ondo state, west Nigeria	Community Health Officers (CHOs) / Primary	Total recruited n=282; 203	Awareness and emergency preparedness	Tablet computer; tutorial application	Not reported	2 weeks (multiple views)	6/9

Author	Year	Location	Cadre of FLHW	Sample size of evaluation	Disease / practice area & health service	Digital device & platform	Language	Duration of training	Appraisal score
			healthcare (PHC) workers, nurses/midwives, laboratory scientists, auxiliary nurses, pharmacy technicians and health record staff	completed all surveys	for Ebola virus disease (EVD)			of tutorial allowed)	
Pimmer et al. [24]	2016	Rural KwaZulu Natal, South Africa	Experienced clinical nurses (during an advanced midwifery education program)	Total n=47; 37 completed all evaluations	Research on any midwifery topic	Mobile phone, Facebook	Not reported	5 months	6/9
McConnell et al. [33]*	2017	Guatemala	Community Health Nurses (CHNs)	n=7	Management of child health topics (including anaemia, ear infections, zinc, urinary tract infections, antibiotics, vaccines, obesity, vitamin A, injury prevention, and burns)	Computers, laptops, tablets, and mobile phones; Videoconferencing (via Vidyo)	Spanish and English	2 blocks of 5 topics each; 1 lecture (45 minutes) per week for 5 weeks per block	6/9
Rahimi, Fahami & Najimi [34]	2017	Isfahan, Iran	Midwives	Total n=96; intervention group n=48, control group n=48	Management of pre-eclampsia	Smartphone; educational software (information and	Not reported	Not reported	7/9

Author	Year	Location	Cadre of FLHW	Sample size of evaluation	Disease / practice area & health service	Digital device & platform	Language	Duration of training	Appraisal score
						multiple choice questions)			
<i>Randomised controlled trials (n=4)</i>									
Sranacharoenpong et al. [23]	2009	5 districts in Chiang Mai province, Thailand	Community Health Care Workers (CHCWs)	Total n=69; intervention group n=35, control group n=34	Diabetes prevention	Computer; e-Learning website (www.FitThai.org)	Thai	4 months, 8 in-classroom discussions (2.5-3 hours) and 8 online learning sessions	8/13
Chen et al. [28]	2014	Gansu province, north-western China	Health workers included family physicians, nurses, public health practitioners, pharmacists, midwives and laboratory technicians	First survey: intervention group n=348, control group n=349. Second survey: intervention group n=301, control group n=332	Clinical recommendation for management of infections affecting the upper respiratory tract and middle ear, including the common cold, influenza, pharyngitis, tonsillitis, and otitis media	Mobile phone; text messages	Chinese	6 weeks; total of 18 messages sent 3 times per week	8/13
Mastellos et al. [12]	2018	Mzuzu, northern Malawi	Health Surveillance Assistants (HSAs)	Total n=39; intervention group n=20, control group n=19	Not reported	Computer and mobile phone; eLearning content consisted of videos with script-guided lectures created with Adobe Premiere	English and Tumbuka	3 weeks; 3 sessions on campus (eLearning in computer lab), 5 sessions offsite (mLearning at HSA's home or	11/13

Author	Year	Location	Cadre of FLHW	Sample size of evaluation	Disease / practice area & health service	Digital device & platform	Language	Duration of training	Appraisal score
						Pro and Microsoft PowerPoint which could be accessed via mobile phone.		work) to make up 21 hours face-to-face learning hours and 10 hours of independent study	
O'Donovan et al. [7]*	2018	Mukono district, Uganda	Community Health Workers (CHWs)	Total recruited n=163. Pre-intervention: Intervention group n=77, control group n=86. Post-intervention: Intervention group n=63, control group n=66	Management of pneumonia	Tablet computer; instructional video	Luganda and English	Half-day workshop on tablet use, 5 days to view instructional videos before post-training assessment	10/13
<i>Cross-sectional studies (n=4)</i>									
Woods et al. [25]	2012	South Africa	Midwives	Total n=50; n=25 in private sector, n=25 in public sector)	Management, perinatal and maternal care	Mobile phone; text messages	Not reported	6 months; total of 26 messages sent once a week	1/8
Chipps et al. [29]	2015	KwaZulu-Natal, South Africa	Midwives	n=56	Not reported	Mobile phone, smartphone, computer, laptop; social networks (Facebook), SMS,	Not reported	Not reported	4/8

Author	Year	Location	Cadre of FLHW	Sample size of evaluation	Disease / practice area & health service	Digital device & platform	Language	Duration of training	Appraisal score
Asgary et al. [27]*	2016	Ga East district in Accra, Ghana	Community Health Nurses (CHNs)	n=15	Screening for cervical cancer	texting, phone calls Smartphone; digital photography and WhatsApp	Not reported	2-week on-site introductory course followed by 2 days field training and a 3-month offsite mHealth training phase	6/8
Yeates et al. [32]	2016	Meru district, northern Tanzania	Nurses and assistant medical officers	n=5	Screening for cervical cancer	Smartphone; digital photography	Kiswahili	6-day competency-based training, followed by training in smartphone camera use as well as training on the study protocol (confidentiality and troubleshooting).	6/8
<i>Qualitative studies (n=1)</i>									
Bellina et al. [36]	2014	Uganda, Bangladesh (Djinapur), Afghanistan (Herat), Madagascar, DRC and Thailand	Laboratory technician students, trained laboratory technicians, female health workers (fully trained nurses and nursing students),	n=114	Diagnosis and treatment of local diseases	Computer and mobile phone; microscope images shown on a computer, digital photos of real microscope slides sent to remote teacher /	Not reported, but the learning approach is locally contextualised which may include translation	Not reported	1/10

Author	Year	Location	Cadre of FLHW	Sample size of evaluation	Disease / practice area & health service	Digital device & platform	Language	Duration of training	Appraisal score
			nursing students, doctors			colleague / higher reference centre	into local languages.		
Pimmer & Mbvundula [35]	2018	Malawi	Health Surveillance Assistants (HSAs)	n=29	Prevention and cure; nutrition, water purification and new-born care	Smartphone; CommCare application audio files used for audio counselling	Chichewa	Not reported	9/10

* next to authors indicates pilot studies

Training characteristics

Training content

All but one study reported details of training content, as it researched FLHWs' existing ICT usage and its effectiveness for work and educational purposes [29]. Training content was relevant to the health service and practice area FLHWs worked in. Content was based on literature, course materials and the professional experiences of collaborating experts [23, 27, 32], essential learning material from established intervention programs [24, 25, 31, 33, 35], peer-reviewed publication and the Cochrane Library [28], national training curriculum, protocols and international guidelines [7, 26, 30, 34], and an educational teaching book [12].

Training pedagogies and findings

Findings of the digital training programs for FLHWs are discussed below according to the three training pedagogies discussed in the Dalberg report [10]:

1. Didactic training techniques: Four studies used didactic techniques and in all four FLHWs reported knowledge improvement. In three studies FLHWs received text messages with information [25, 28, 31] and in one FLHWs watched educational videos [7], all without any interactive component. Of the two studies with control groups, one reported no significant between-group difference for improvement in assessment scores [7] whereas the other study reported significant increase in the average score in the intervention group compared to the control group [28]. Regarding attitudes and perceptions of digital training tools, Woods et al. [25] reported that 86% of FLHWs enjoyed and learned from the messages, 72% believed that the messages improved their clinical practice, and 100% wanted to receive further messages on other health topics. Similarly, Chen et al. [28] reported frequent adoption of the intervention content in their clinical decision-making by one third of the intervention group and 95% wanted to continue receiving text messages. Similarly, most of O'Donovan et al.'s [7] intervention group reported a positive experience using the digital training tool. Otu et al. [31] reported reinforcement of positive attitudes and more positive response in favour of desirable clinical practices to prevent spreading of Ebola. Chen et al. [28] reported positive changes in prescription practices by family physicians (the only cadre

allowed to prescribe medicine in this study) which resulted in less antibiotics and steroids being prescribed for viral infections.

2. Interactive training techniques: Six studies used interactive techniques where FLHWs were presented with learning material via interactive voice response (IVR) [26], videoconferencing [33], eToolkit and eLearning courses [30], and educational software [34] which all included interactive components, e.g. multiple choice questions that were answered, where FLHWs interacted with a research supervisor [24] and used the mobile phone for digital image sharing [36]. Regarding knowledge improvement, FLHWs affirmed enhanced competence [36] and substantial knowledge increases (10-30%) across intervention subject areas [30]. Two studies reported significant improvements in knowledge: significant increase in average scores directly after training and after 10 months (despite a slight decline) [26] and significant mean score difference post-intervention for intervention and control groups [34] (also the only study in this category with a control group). All studies reported positive attitudes and perceptions of digital training tools, specifically: ease of use and easy to understand content [26, 30, 36]; relevance and viability as learning source [35] preference for digital courses [36] through which FLHWs learned the same or more compared to traditional courses [26]; and, enhanced position in and relationships with their communities [36]. Diedhiou et al. [26] reported 60% of FLHWs appreciated determining their learning pace, 55% appreciated the convenience and 40% the flexibility to access the course anywhere. For research supervision, FLHWs in the Pimmer et al. [24] study reported that Facebook became a more integral part of their educational activities with significantly higher rates of Facebook use for learning activities after the intervention. However despite significant increases in agreement on the importance of Facebook for learning and nursing education immediately post-intervention, agreement was not maintained 3 months after the intervention and returned to pre-intervention levels [24].

3. Blended learning approach: Six studies used a blended learning approach (as per the Dalberg report [10] definition). All six studies reported positive results for knowledge improvement, with two reporting significant knowledge improvement post-intervention [12, 23], and one reported significant between-group differences [23]. The two studies on cervical cancer screening both reported positive agreement rates of

89.6% [27] and 96.8% [32] between participants and expert reviewers, with very high agreement rates for negative cases [27] and a reduction of $\pm 10\%$ to less than 3% in initial disagreement between participants and expert reviewers [32]. FLHWs were extremely satisfied with the blended learning approaches [23, 33] and showed more significant positive attitudinal gains in the blended learning group compared to the control group [12]. According to Sranacharoenpong et al. [23] 83% of FLHWs liked the blended learning approach, 68% learned new content, 97% could apply content on the job, 80% found the training materials helpful, and 54% felt more confident in conveying the content to at-risk populations. However, Mastellos et al. [12] reported that the intervention group found it more difficult to follow course content and enjoyed the blended learning course less than the control group enjoyed traditional learning.

Challenges related to implementation of digital training for FLHWs

All studies, except one [36], reported challenges in the implementation of the digital training program. Studies experienced the following logistical challenges: poor infrastructure for ICT e.g. lack of internet access [12, 24, 25], slow bandwidth at rural hospitals [29], variability in reliability of cellular networks in remote areas [26, 33], telephone network contract and difficulties with loading airtime [26], issues with the digital platform capacity for accessing multiple voice lines simultaneously [26], securing necessary supplies [27], limited electricity supply [12], difficulty disseminating information due to limited number of characters available in a text message [28], low personal computer ownership [12, 29], and FLHWs' workload and limited time for health promotion activities [23]. Digital literacy challenges included: low levels of technical and computer competency, difficulty using new technology and low usage of smartphone functions [29], the need to develop critical social media literacy skills [24], and despite completion of the device training component, ICT competence remained elementary [7, 12]. Institutional support challenges included: out of date technologies used for educational purposes at workplaces and universities [29], no centralised model for training therefore training is provided by various NGOs [7] and long-term sustainability, scalability and FLHW participation in digital training programs need cooperation from district, provincial and national levels of government and their commitments to include the health services that FLHWs provide within healthcare strategies [23, 29].

Factors facilitating implementation of digital training programs for FLHWs

All studies reported facilitating factors for implementation of the digital training programs. The most reported facilitating factors were: cost-effectiveness [12, 24-26, 28, 33-35], ease and convenience of use, accessibility of information and “infinite transmission of data” [36] via the various devices but specifically via mobile or smartphones [7, 24-26, 28, 29, 31, 34], and FLHWs had existing digital skills or reported that the necessary digital literacy skills were easy to learn [12, 23-25, 28-30, 32, 36]. Some studies reported institutional support, training as part of an existing FLHW program within the health system and leveraging existing relationships with institutions to get support for digital training programs [23, 27, 32, 33, 35]. Also, digital training programs were contextualised and appropriate for the specific populations the FLHWs served [7, 25-28, 30, 33, 35, 36]. Other facilitating factors were: digital training removed power relations between instructors and students [36], digital platforms enabled easy sharing of up-to-date information compared to textbooks and other printed learning materials [7, 28], and digital training did not disrupt FLHWs’ service delivery [7, 12, 26, 33, 35]. Because training is mobile and resource-effective, FLHWs can serve hard-to-reach communities, e.g. cervical cancer screening that no longer requires specialised equipment [32, 33].

Discussion

The aim of this systematic review was to describe and critically assess the aspects of digital training for FLHWs in LMICs. Findings from this review are consistent with evidence from other studies of the potential of digital health to “improve the efficiency of the health workforce, advance quality health services coverage, and enable better health outcomes” (p. S43, [4]). In recent years, eHealth and especially mHealth technologies and interventions attracted much attention as potential ways to meet shortages and demands – in the case of this review, in training FLHWs in LMICs. This review includes articles that highlight the spectrum of characteristics of digital training, including the different countries, cadres of FLHWs, health services and practice areas but more interestingly the differences in devices as well as ways and pedagogies of training.

Mobile and/or smartphones were used in most studies (12 out of 16), consistent with the literature on the ubiquity of mobile phones and increased access to mobile networks in LMICs, and the global increase of mobile phone subscriptions since the year 2000 [37]. Mobile and smartphones enable FLHWs to access training materials and information without the hindrances associated with computer-based training, e.g. substandard computer resources and unreliable internet connections [38, 39]. The ability to share knowledge through online discussion directly by the mobile phone or via social media enhances the learning environment [40]. O'Donovan et al. [7] specifically allude to the resource-effectiveness mobile devices used for refresher training, e.g. training delivery requires fewer supervisors and it is less time consuming than attending traditional refresher training as all necessary materials are available on the mobile device. A reported facilitating factor was that digital health allows for contextualization, and in the context of training, it is argued that the use of mobile devices enables generation of new and more personal learning content and events, especially in marginalised contexts such as LMICs, which allows learners (in this case, FLHWs) to gain a critical consciousness and enhance their agency [41].

In this review, blended learning approaches were as frequently used as interactive techniques (6 studies in each group). Even though the didactic training techniques (used in 4 studies) reported positive results for increased knowledge and positive perceptions, FLHWs reported a negative aspect in the lack of interaction with the training system and with instructors and/or colleagues [28]. The interactive and blended learning techniques made up for this limitation, and blended learning approaches were considered at least as effective, if not more effective, than traditional techniques [10]. Multimedia use in both approaches, whether in a classroom or accessed on a digital device or both, facilitates interactive and repetitive exposure to learning materials [10]. Importantly, the didactic training techniques focused purely on a passive transfer of information, whereas the interactive and blended learning approaches enabled a transfer and acquisition of skills in addition to information. The use of multimedia in digital training engages FLHWs, even those with lower levels of literacy and education as the content is not purely text-based [7, 26, 30, 36].

All studies alluded to the lack of evidence on the effectiveness of digital training beyond the pilot phase and lack of long-term findings regarding improved service provision or community behaviour change as a result of FLHW training. Cost-effectiveness was

considered as a facilitating factor for using digital tools, however McConnell et al. [33] discussed the difficulty of conducting cost-effective analyses. These analyses are important for generalisability and when considering scaling, as different parts and partners are involved in intervention implementation (e.g. quantifying experts' time in content contribution or when sharing resources with a clinic or university).

Although findings are positive overall and digital training is generally considered as feasible, appropriate, and relevant for use in LMICs, a participatory strategy in designing and developing training interventions should be considered [7, 30]; one that involves not only the experts in subject areas and technologists but also the end users to ensure that content is directly applicable to the FLHWs' situations and needs [7, 30, 33]. This confirms FLHWs' place in the health system as important which serves as motivation to fully embrace the training, and results in improved knowledge which in turn leads to increased self-efficacy for both ICT-related and service tasks as manifested in improved skills [3].

Strengths and Limitations

Despite heterogeneity in study designs, comparison of many characteristics (e.g. length of training, devices, and training pedagogies) was possible. Broad search terms ensured that all types of training, cadres of FLHWs and LMICs were included without any bias towards only certain types, cadres or countries.

Exclusion of grey literature, studies published in non-English languages, descriptive studies, conference abstracts and poster presentations, is a risk for bias. The literature alluded to the lack of published findings of evaluations of digital training programs for FLHWs in LMICs, which could imply that because studies are mostly in the pilot phase or that training forms part of a larger intervention, these findings are not published but indeed written up as reports, descriptive studies, conference abstracts or poster presentations.

To prevent selection bias, abstract and full-text screening involved multiple people, however the final data extraction and appraisal was performed by one reviewer. For quality control a second reviewer reviewed all the included articles. No studies were excluded on the grounds of quality based on their appraisal score, rather the appraisal

criteria and scores were tabulated and included. It is thought that bias was also minimised by broad search terms and strict inclusion/exclusion criteria.

Conclusions

This review discussed a range of characteristics of FLHW training in LMICs. The implication of this range and the fact that no two studies used the same protocol for intervention implementation or evaluation made comparison and generalisation difficult, especially with regard to effectiveness of digital training. However, by exploring these characteristics across studies, some insight could be gathered into the feasibility and usability of digital tools for FLHW training.

All studies reported increased knowledge following digital training and positive perceptions of the use of digital devices and platforms. Mobile devices, specifically mobile and smartphones, are preferred for training as mobile phone access exceeds computer access globally (especially in rural areas which are difficult to reach). Interactive or blended-learning approaches enable FLHWs to access information easily, flexibly, repetitively, as well as cost- and time-effectively.

Considering the role of FLHW training to reach UHC, digital training will become more common over time as the world continues to become more digitized. Therefore, implementing parties should equip those working at the frontlines with the necessary digital literacy skills to maximise the advancements of technology as well as the necessary information and skills to perform their tasks optimally.

Digital FLHW training effectiveness as seen in improved service or health behaviour change at community level, will only be determined by long-term findings, therefore interventions need to move beyond the pilot phase.

List of abbreviations

CHCW: community healthcare worker; CHN: community health nurse; CHO: community health officer; CHW: community health worker; eHealth: electronic health; EVD: Ebola virus disease; FLHW: frontline health worker; FWA: family welfare assistant; HA: health assistant; HAS: health surveillance assistant; IVR: interactive voice response; LMIC: low- and middle-income country; MeSHL medical subject

headings; mHealth: mobile health; PHC: primary healthcare; RCT: randomized controlled trial; RMNCH: reproductive, maternal, newborn and child health; UN: United Nations; WHO: World Health Organization

Declarations

Ethics approval and consent to participate: As this is a systematic review and no human subjects were involved in the research, no ethics committee approval was required.

Consent for publication: All authors provided consent for this publication.

Availability of data and material: All relevant data are within the paper. Additional data could be available upon request to the corresponding author.

Competing interests: The author has no competing interests.

Funding: This review was not funded in any way.

Authors' contributions: AEL planned the study and along with AS oversaw the review process. FS conducted the review, collected the review articles and summarized the findings. AS and AEL provided supervision and commented on the final draft. All authors approved the final draft of the paper.

Acknowledgements: This review forms part of a series of reviews about the use of digital tools for FLHWs in LMICs, and I would like to thank the review team for their input and contributions to this review.

Authors' details: All authors are affiliated with the University of Cape Town, South Africa.

References

1. Darzi A, Evans T. The global shortage of health workers - an opportunity to transform care. *The Lancet*. 2016;388:2576-7.
2. Stenberg K, Hanssen O, Tan-Torres Edejer T, Bertram M, Brindley C, Meshreky A, et al. Financing transformative health systems towards achievement of the health Sustainable Development Goals: a model for projected resource needs in 67 low-income and middle-income countries. *The Lancet Global Health*. 2017;5(9):e875-e87.
3. Abejirinde IO, Ilozumba O, Marchal B, Zweekhorst M, Dieleman M. Mobile health and the performance of maternal health care workers in low- and middle-income countries: A realist review. *International Journal of Care Coordination*. 2018;21(3):73-86.
4. Long L, Pariyo G, Kallander K. Digital technologies for health workforce development in low- and middle-income countries: A scoping review. *Global Health: Science and Practice*. 2018;6(Supplement 1):S41-8.
5. World Health Organization. Annual report on monitoring progress on UHC and the health-related SDGs. WHO; 2018 7 August 2018. Contract No.: Provisional Agenda item 8.5.
6. Agarwal S, Perry HB, Long L, Labrique AB. Evidence on feasibility and effective use of mHealth strategies by frontline health workers in developing countries: systematic review. *Tropical Medicine & International Health*. 2015;20(8):1003-14.
7. O'Donovan J, Kabali K, Taylor C, Chukhina M, Kading JC, Fuld J, et al. The use of low-cost Android tablets to train community health workers in Mukuno, Uganda, in the recognition, treatment and prevention of pneumonia in children under five: a pilot randomised controlled trial. *Human Resources for Health*. 2018;16(49):1-9.
8. Todd CS, Mills SJ, Innes AL. Electronic health, telemedicine, and new paradigms for training and care. *Current Opinion in HIV and AIDS*. 2017;12(5):475-87.
9. Batavia H, Kaonga N. mHealth support tools for improving the performance of frontline health workers: An inventory and analytical review. *mHealth Alliance*; 2014.
10. Dalberg Global Development Advisors. Preparing the next generation of community health workers: The power of technology for training. *iheed Institute*; 2012.

11. Agarwal S, Rosenblum L, Goldschmidt T, Carras M, Goal N, Labrique AB. Mobile technology in support of frontline health workers: A comprehensive overview of the landscape, knowledge gaps and future directions. <https://www.mhealthknowledge.org/resources/mobile-technology-support-frontline-health-workers-comprehensive-overview-landscape>: Johns Hopkins University Global Health mHealth Initiative 2016; 2016.
12. Mastellos N, Tran T, Dharmayat K, Cecil E, Lee H, Peng Wong CC, et al. Training community healthcare workers on the use of information and communication technologies: a randomised controlled trial of traditional versus blended learning in Malawi, Africa. BMC Medical Education. 2018;18(61):1-13.
13. Moore C. Frontline Health Workers Coalition [Internet]. <https://www.frontlinehealthworkers.org/blog/connecting-frontline-health-workers-training-and-information2015>. [cited 2018]. Available from: <https://www.frontlinehealthworkers.org/blog/connecting-frontline-health-workers-training-and-information>.
14. Mehl GL, Tamrat T, Bhardwaj S, Blaschke S, Labrique AB. Digital health vision: could MomConnect provide a pragmatic starting point for achieving universal health coverage in South Africa and elsewhere? BMJ Global Health. 2018;3:e000626.
15. Bluestone J, Johnson P, Fullerton J, Carr C, Alderman J, BonTempo J. Effective in-service training design and delivery: evidence from an integrative literature review. Human Resources for Health. 2013;11(51):1-26.
16. Odendaal WA, Goudge J, Griffiths F, Tomlinson M, Leon N, Daniels K. Healthcare workers' perceptions and experience on using mHealth technologies to deliver primary healthcare services: qualitative evidence synthesis. Cochrane Database of Systematic Reviews. 2015;11(Art. No: CD011942).
17. World Health Organization. Classification of digital health interventions. Geneva: World Health Organization; 2018, <https://www.who.int/reproductivehealth/publications/mhealth/classification-digital-health-interventions/en/>.
18. Frontline Health Workers Coalition. IntraHealth International; 2018 [Available from: <https://www.frontlinehealthworkers.org/who-they-are>].
19. The Broadband Commission for Sustainable Development. Digital Health: A Call for Government Leadership and Cooperation between ICT and Health. 2017.

20. World Health Organization. Monitoring and evaluating digital health interventions: a practical guide to conducting research and assessment. 2016.
21. Labrique AB, Vasudevan L, Kochi E, Fabricant R, Mehl G. mHealth innovations as health system strengthening tools: 12 common applications and a visual framework. *Global Health: Science and Practice*. 2013 Aug 6;1(2):160-71.
22. The Joanna Briggs Institute. Joanna Briggs Institute Reviewers' Manual: 2014 Edition. Adelaide, Australia: The Joanna Briggs Institute; 2014.
23. Sranacharoenpong K, Hanning RM, Sirichakwal PP, Chittchang U. Process and outcome evaluation of a diabetes prevention education program for community healthcare workers in Thailand. *Education for Health*. 2009;22(3):1-12.
24. Pimmer C, Chipps J, Brysiewicz P, Walters F, Linxen S, Gröbriel U. Supervision on social media: Use and perception of Facebook as a research educational tool in disadvantaged areas. *International Review of Research in Open and Distributed Learning*. 2016;17(5):2000-14.
25. Woods D, Attwell A, Ross K, Theron G. Text messages as a learning tool for midwives. *South African Medical Journal*. 2012;102(2):100-1.
26. Diedhiou A, Gilroy KE, Cox CM, Duncan L, Koumtingue D, Pacqué-Margolis S, et al. Successful mlearning pilot in Senegal: Delivering family planning refresher training using interactive voice response and SMS. *Global Health: Science and Practice*. 2015;3(2):305-21.
27. Asgary R, Adongo PB, Nwameme A, Cole HVS, Maya E, Liu M, et al. mHealth to train community health nurses in Visual Inspection with Acetic Acid for cervical cancer screening in Ghana. *Journal of Lower Genital Tract Disease*. 2016;20(3):239-42.
28. Chen Y, Yang K, Jing T, Tian J, Shen X, Xie C, et al. Use of text messages to communicate clinical recommendations to health workers in rural China: a cluster-randomized trial. *Bulletin of the World Health Organization*. 2014;92:474-81.
29. Chipps J, Pimmer C, Brysiewicz P, Walters F, Linxen S, Ndebele T, et al. Using mobile phones and social media to facilitate education and support for rural-based midwives in South Africa. *Curationis*. 2015;38(2):8.
30. Limaye RJ, Deka S, Ahmed N, Mwaikambo L. Designing eLearning courses to meet the digital literacy needs of healthcare workers in lower- and middle-income

countries: Experiences from the Knowledge for Health Project. *Knowledge Management & E-Learning*. 2015;7(4):601-15.

31. Otu A, Ebenso B, Okuzu O, Osifo-Dawudo E. Using a mHealth tutorial application to change knowledge and attitude of frontline health workers to Ebola virus disease in Nigeria: a before-and-after study. *Human Resources for Health*. 2016;14(5):1-9.

32. Yeates KE, Sleeth J, Hopman W, Ginsburg O, Heus K, Andrews L, et al. Evaluation of a smartphone-based training strategy among health care workers screening for cervical cancer in northern Tanzania: The Kilimanjaro Method. *Journal of Global Oncology*. 2016;2(6):356-64.

33. McConnell KA, Krisher LK, Lenssen M, Bunik M, Montes SB, Domek GJ. Telehealth to expand community health nurse education in rural Guatemala: A pilot feasibility and acceptability evaluation. *Frontiers in Public Health*. 2017;5(60):1-8.

34. Rahimi MS, Fahami F, Najimi A. The effectiveness of training through mobile on the practice of midwives in the management of pre-eclampsia. *Biomedical & Pharmacology Journal*. 2017;10(2):781-6.

35. Pimmer C, Mbvubdula F. One message, many voices: Mobile audio counselling in health education. *Journal of Health Care for the Poor and Underserved*. 2018;29(1):463-80.

36. Bellina L, Azzolina G, Nucatola I, Maggio A, Consiglio F, Ingrassia R, et al. M-phone impact on practical training: role of m-phone as part of the educative method for training local workers of rural areas of developing countries. *Health Technology*. 2014;4:289-94.

37. Novillo-Ortiz D, Marin HF, Saigi-Rubio F. The role of digital health in supporting the achievement of the Sustainable Development Goals (SDGs). *International Journal of Medical Informatics*. 2018;114:106-7.

38. Armstrong K, Liu F, Seymour A, Mazhani L, Littman-Quinn R, Fontelo P, et al. Evaluation of txt2MEDLINE and development of short messaging service-optimized, clinical practice guidelines in Botswana. *Telemedicine and e-Health*. 2012;18(1):14-7.

39. Chang AY, Ghose S, Littman-Quinn R, Anolik RB, Kyer A, Mazhani L, et al. Use of mobile learning by resident physicians in Botswana. *Telemedicine and e-Health*. 2012;18(1):11-3.

40. Zolfo M, Iglesias D, Kiyan C, Echevarria J, Fucay L, Llacsahuanga E, et al. Mobile learning for HIV/AIDS healthcare worker training in resource-limited settings. *AIDS Research and Therapy*. 2010;7(35):1-6.
41. Winters N, Oliver M, Langer L. Can mobile health training meet the challenge of 'measuring better'? *Comparative Education*. 2017;53(1):115-31.

Part D: Appendices

Appendix A: Search terms

PubMed 4/7/2018

Concept 1: mHealth 196943 results

("Telemedicine"[Mesh] OR "Mobile Applications"[Mesh] OR "telemedicine"[tw] OR "telehealth"[tw] OR "digital health"[tw] OR "mobile"[tw] OR "Telephone"[Mesh] OR "phone"[tw] OR "phones"[tw] OR "telephone"[tw] OR "telephones"[tw] OR "smartphone"[tw] OR "smartphones"[tw] OR "iphone"[tw] OR "iphones"[tw] OR "android"[tw] OR "androids"[tw] OR "mHealth"[tw] OR "eHealth"[tw] OR "Information Technology"[Mesh] OR "information technology"[tw] OR "information technologies"[tw] OR "communication technology"[tw] OR "communication technologies"[tw] OR (("cellular "[tw] OR "wearable"[tiab] OR "digital"[tiab]) AND ("technology"[tw] OR "technologies"[tw])) OR ((cellular[tw] OR mobile[tw] OR phone[tw] OR smart[tw] OR text[tiab] OR tablet[tiab] OR digital[tiab] OR electronic[tiab] OR interactive[tiab] OR translation[tiab] OR software[tiab] OR tablet[tiab]) AND ("app"[tiab] OR "apps"[tiab] OR "application"[tiab] OR "applications"[tiab] OR alert[tiab] OR alerts[tiab] OR reminder[tiab] OR reminders[tiab])) OR "mobile device"[tw] OR "mobile devices"[tw] OR "SMS"[tw] OR "short message service"[tw] OR "text message"[tw] OR "text-message"[tw] OR "ipad"[tw] OR "text messages"[tw] OR "text-messages"[tw] OR "text messaging"[tw] OR "text-messaging"[tw] OR "texting"[tw] OR "textings"[tw] OR "text contact"[tw] OR "text contacts"[tw] OR "interactive voice response"[tw]) AND ("2008/01/01"[PDAT] : "2018/12/31"[PDAT])

Concept 2: Health worker 27941 results

("community health workers"[MeSH Terms] OR "community health worker"[tw] OR "community health workers"[tw] OR ("community health"[tiab] OR "village health"[tiab]) AND ("worker"[tiab] OR "workers"[tiab] OR "staff"[tiab] OR "staffing"[tiab] OR "personnel"[tiab] OR "agent"[tiab] OR "agents"[tiab] OR "volunteer"[tiab] OR "volunteers"[tiab] OR "aide"[tiab] OR "aides"[tiab] OR "auxiliary"[tiab] OR "auxiliaries"[tiab] OR "helper"[tiab] OR "helpers"[tiab])) OR "CHW"[tw] OR "CHWs"[tw] OR "community health aide"[tw] OR "community health aides"[tw] OR "family planning personnel"[tw] OR "midwifery"[MeSH Terms] OR "traditional birth attendant"[tw] OR "traditional birth attendants"[tw] OR "skilled birth attendant"[tw] OR "skilled birth attendants"[tw] OR "frontline worker"[tw] OR "frontline workers"[tw] OR "health worker"[tw] OR "health workers"[tw] OR "lay worker"[tw] OR "lay workers" OR "village health worker"[tw] OR "village health workers"[tw] OR "VHW"[tw] OR "VHWs"[tw] OR "midwife"[tw] OR "midwives"[tw] OR "barefoot doctors"[tw] OR "barefoot doctor"[tw] OR "health auxiliary"[tw] OR "health auxiliaries"[tw] OR "peer health worker"[tw] OR "peer health workers"[tw] OR "medical auxiliary"[tw] OR "medical auxiliaries"[tw] OR "health provider"[tw] OR "health providers"[tw] OR "lay counselor"[tw] OR "lay counselors"[tw] OR "lady health worker"[tw] OR "lady health workers"[tw] OR "LHW"[tw] OR "LHWs"[tw] OR "lay educator"[tw] OR "lay educators"[tw] OR "Activista"[tw] OR "activistas"[tw] OR "Agente comunitario de salud"[tw] OR "agentes comunitarios de salud"[tw] OR "Anganwadi"[tw] OR "accredited social health activist"[tw] OR "accredited social health activists"[tw] OR "ASHA"[tw] OR "ASHAs"[tw] OR "Animatrice"[tw] OR "animatrices"[tw] OR "Barangay health worker"[tw] OR "Barangay Health Workers"[tw] OR "Basic health worker"[tw] OR "basic health workers"[tw] OR "Brigadista"[tw] OR "brigadistas"[tw] OR "Colaborador voluntario"[tw] OR "Colaboradores voluntarios"[tw] OR "Community drug distributor"[tw] OR "community drug distributors"[tw] OR "Community health agent"[tw] OR "community health agents"[tw] OR "Community health promoter"[tw] OR "community health promoters"[tw] OR "Community health representative"[tw] OR "community health representatives"[tw] OR "Community health volunteer"[tw] OR "community health volunteers"[tw] OR "community nutrition workers"[tw] OR "community nutrition volunteer"[tw] OR "Community nutrition worker"[tw] OR "community nutrition volunteers"[tw] OR "Community resource person"[tw] OR "community resource persons"[tw] OR "Female community health volunteer"[tw] OR "female community health volunteers"[tw] OR "Female multipurpose health worker"[tw] OR "female multipurpose health workers"[tw] OR "Health promoter"[tw] OR "health promoters"[tw] OR

"Kader"[tw] OR "kaders"[tw] OR "Maternal and child health worker"[tw] OR "maternal and child health workers"[tw] OR "Monitora"[tw] OR "monitoras" [tw] OR "Mother coordinator"[tw] OR "mother coordinators"[tw] OR "Outreach educator"[tw] OR "outreach educators"[tw] OR "Promotora"[tw] OR "Promotoras"[tw] OR "Rural health motivator"[tw] OR "rural health motivators"[tw] OR "Shastho shebika"[tw] OR "Shasthya Shebika"[tw] OR "Shasthya Shebikas"[tw] OR "Sevika"[tw] OR "sevikas"[tw] OR "Village health helper"[tw] OR "village health helpers"[tw] OR "Village drug-kit manager"[tw] OR "village drug-kit managers"[tw] OR "Saksham Sahaya"[tw] OR "Saksham Sahayaks"[tw] OR "Raedat"[tw] OR "Raedat Refiat"[tw] OR "Accompagnateurs"[tw] OR "Accompagnateur"[tw] OR "Behvarz"[tw] OR "behvarzan"[tw] OR "Dai"[tw] OR "Dais"[tw] OR "Bidan Kampong"[tw] OR "bidan kampungs"[tw] OR "bidan kampong"[tw] OR "agents de santé"[tw] OR "agent de santé"[tw]) AND ("2008/01/01"[PDAT] : "2018/12/31"[PDAT])

Concept 3:LMIC filter (#2 from Cochrane 2012) 808236 results

((("developing country"[tw] OR "developing countries"[tw] OR "developing nation"[tw] OR "developing nations"[tw] OR "developing population"[tw] OR "developing populations"[tw] OR "developing world"[tw] OR "less developed country"[tw] OR "less developed countries"[tw] OR "less developed nation"[tw] OR "less developed nations"[tw] OR "less developed world"[tw] OR "lesser developed countries"[tw] OR "lesser developed nations"[tw] OR "under developed country"[tw] OR "under developed countries"[tw] OR "under developed nations"[tw] OR "under developed world"[tw] OR "underdeveloped country"[tw] OR "underdeveloped countries"[tw] OR "underdeveloped nations"[tw] OR "underdeveloped population"[tw] OR "underdeveloped world"[tw] OR "middle income country"[tw] OR "middle income countries"[tw] OR "middle income nation"[tw] OR "middle income nations"[tw] OR "middle income population"[tw] OR "middle income populations"[tw] OR "low income country"[tw] OR "low income countries"[tw] OR "low income nation"[tw] OR "low income nations"[tw] OR "low income population"[tw] OR "low income populations"[tw] OR "lower income country"[tw] OR "lower income countries"[tw] OR "lower income nations"[tw] OR "lower income population"[tw] OR "lower income populations"[tw] OR "underserved countries"[tw] OR "underserved nations"[tw] OR "underserved population"[tw] OR "underserved populations"[tw] OR "under served population"[tw] OR "under served populations"[tw] OR "deprived countries"[tw] OR "deprived population"[tw] OR "deprived populations"[tw] OR "poor country"[tw] OR "poor countries"[tw] OR "poor nation"[tw] OR "poor nations"[tw] OR "poor population"[tw] OR "poor populations"[tw] OR "poor world"[tw] OR "poorer countries"[tw] OR "poorer nations"[tw] OR "poorer population"[tw] OR "poorer populations"[tw] OR "developing economy"[tw] OR "developing economies"[tw] OR "less developed economy"[tw] OR "less developed economies"[tw] OR "underdeveloped economies"[tw] OR "middle income economies"[tw] OR "low income economy"[tw] OR "low income economies"[tw] OR "low gdp"[tw] OR "low gnp"[tw] OR "low gross domestic"[tw] OR "low gross national"[tw] OR "lower gdp"[tw] OR "lower gross domestic"[tw] OR lmic[tw] OR lmic[s] OR "third world"[tw] OR "lami country"[tw] OR "lami countries"[tw] OR "transitional country"[tw] OR "transitional countries"[tw]) OR (Africa[tw] OR Asia[tw] OR Caribbean[tw] OR West Indies[tw] OR South America[tw] OR Latin America[tw] OR Central America[tw] OR Afghanistan[tw] OR Albania[tw] OR Algeria[tw] OR Angola[tw] OR Antigua[tw] OR Barbuda[tw] OR Argentina[tw] OR Armenia[tw] OR Armenian[tw] OR Aruba[tw] OR Azerbaijan[tw] OR Bahrain[tw] OR Bangladesh[tw] OR Barbados[tw] OR Benin[tw] OR Byelarus[tw] OR Byelorussian[tw] OR Belarus[tw] OR Belorussian[tw] OR Belorussia[tw] OR Belize[tw] OR Bhutan[tw] OR Bolivia[tw] OR Bosnia[tw] OR Herzegovina[tw] OR Hercegovina[tw] OR Botswana[tw] OR Brasil[tw] OR Brazil[tw] OR Bulgaria[tw] OR Burkina Faso[tw] OR Burkina Fasso[tw] OR Upper Volta[tw] OR Burundi[tw] OR Urundi[tw] OR Cambodia[tw] OR Khmer Republic[tw] OR Kampuchea[tw] OR Cameroon[tw] OR Cameroons[tw] OR Cameron[tw] OR Cape Verde[tw] OR Central African Republic[tw] OR Chad[tw] OR Chile[tw] OR China[tw] OR Colombia[tw] OR Comoros[tw] OR Comoro Islands[tw] OR Comores[tw] OR Mayotte[tw] OR Congo[tw] OR Zaire[tw] OR Costa Rica[tw] OR Cote d'Ivoire[tw] OR Ivory Coast[tw] OR Croatia[tw] OR Cuba[tw] OR Cyprus[tw] OR Czechoslovakia[tw] OR Czech Republic[tw] OR Slovakia[tw] OR Slovak Republic[tw] OR Djibouti[tw] OR French Somaliland[tw] OR Dominica[tw] OR Dominican Republic[tw] OR East Timor[tw] OR (East[All Fields] AND Timur[tw]) OR Timor Leste[tw] OR Ecuador[tw] OR Egypt[tw] OR United Arab Republic[tw] OR El Salvador[tw] OR Eritrea[tw] OR Estonia[tw] OR Ethiopia[tw] OR Fiji[tw] OR Gabon[tw] OR Gabonese Republic[tw] OR Gambia[tw] OR Gaza[tw] OR Georgia Republic[tw] OR Georgian Republic[tw] OR Ghana[tw] OR Gold Coast[tw] OR Greece[tw] OR Grenada[tw] OR Guatemala[tw] OR Guinea[tw] OR Guam[tw] OR Guiana[tw] OR Guyana[tw] OR Haiti[tw] OR Honduras[tw] OR Hungary[tw] OR India[tw] OR Maldives[tw] OR Indonesia[tw] OR Iran[tw] OR Iraq[tw] OR Isle of Man[tw] OR Jamaica[tw] OR Jordan[tw] OR

Kazakhstan[tw] OR Kazakh[tw] OR Kenya[tw] OR Kiribati[tw] OR Korea[tw] OR Kosovo[tw] OR Kyrgyzstan[tw] OR Kirghizia[tw] OR Kyrgyz Republic[tw] OR Kirghiz[tw] OR Kirgizstan[tw] OR "Lao PDR"[tw] OR Laos[tw] OR Latvia[tw] OR Lebanon[tw] OR Lesotho[tw] OR Basutoland[tw] OR Liberia[tw] OR Libya[tw] OR Lithuania[tw]) OR (Macedonia[tw] OR Madagascar[tw] OR Malagasy Republic[tw] OR Malaysia[tw] OR Malaya[tw] OR Malay[tw] OR Sabah[tw] OR Sarawak[tw] OR Malawi[tw] OR Nyasaland[tw] OR Mali[tw] OR Malta[tw] OR Marshall Islands[tw] OR Mauritania[tw] OR Mauritius[tw] OR Agalega Islands[tw] OR Mexico[tw] OR Micronesia[tw] OR Middle East[tw] OR Moldova[tw] OR Moldovia[tw] OR Moldovian[tw] OR Mongolia[tw] OR Montenegro[tw] OR Morocco[tw] OR Ifni[tw] OR Mozambique[tw] OR Myanmar[tw] OR Myanma[tw] OR Burma[tw] OR Namibia[tw] OR Nepal[tw] OR Netherlands Antilles[tw] OR New Caledonia[tw] OR Nicaragua[tw] OR Niger[tw] OR Nigeria[tw] OR Northern Mariana Islands[tw] OR Oman[tw] OR Muscat[tw] OR Pakistan[tw] OR Palau[tw] OR Palestine[tw] OR Panama[tw] OR Paraguay[tw] OR Peru[tw] OR Philippines[tw] OR Philipines[tw] OR Phillipines[tw] OR Phillippines[tw] OR Poland[tw] OR Portugal[tw] OR Puerto Rico[tw] OR Romania[tw] OR Rumania[tw] OR Roumania[tw] OR Russia[tw] OR Russian[tw] OR Rwanda[tw] OR Ruanda[tw] OR Saint Kitts[tw] OR St Kitts[tw] OR Nevis[tw] OR Saint Lucia[tw] OR St Lucia[tw] OR Saint Vincent[tw] OR St Vincent[tw] OR Grenadines[tw] OR Samoa[tw] OR Samoan Islands[tw] OR (Navigator[All Fields] AND Island[tw]) OR (Navigator[All Fields] AND Islands[tw]) OR Sao Tome[tw] OR Saudi Arabia[tw] OR Senegal[tw] OR Serbia[tw] OR Montenegro[tw] OR Seychelles[tw] OR Sierra Leone[tw] OR Slovenia[tw] OR Sri Lanka[tw] OR Ceylon[tw] OR Solomon Islands[tw] OR Somalia[tw] OR Sudan[tw] OR Suriname[tw] OR Surinam[tw] OR Swaziland[tw] OR Syria[tw] OR Tajikistan[tw] OR Tadjikistan[tw] OR Tadjikistan[tw] OR Tadjik[tw] OR Tanzania[tw] OR Thailand[tw] OR Togo[tw] OR Togolese Republic[tw] OR Tonga[tw] OR Trinidad[tw] OR Tobago[tw] OR Tunisia[tw] OR Turkey[tw] OR Turkmenistan[tw] OR Turkmen[tw] OR Uganda[tw] OR Ukraine[tw] OR Uruguay[tw] OR USSR[tw] OR Soviet Union[tw] OR Union of Soviet Socialist Republics[tw] OR Uzbekistan[tw] OR Uzbek[All Fields] OR Vanuatu[tw] OR New Hebrides[tw] OR Venezuela[tw] OR Vietnam[tw] OR Viet Nam[tw] OR West Bank[tw] OR Yemen[tw] OR Yugoslavia[tw] OR Zambia[tw] OR Zimbabwe[tw] OR Rhodesia[tw]) OR ("developing countries"[MeSH Terms:noexp] OR "africa"[MeSH Terms:noexp] OR "africa, northern"[MeSH Terms:noexp] OR "africa south of the sahara"[MeSH Terms:noexp] OR "africa, central"[MeSH Terms:noexp] OR "africa, eastern"[MeSH Terms:noexp] OR "africa, southern"[MeSH Terms:noexp] OR "africa, western"[MeSH Terms:noexp] OR "asia"[MeSH Terms:noexp] OR "asia, central"[MeSH Terms:noexp] OR "asia, southeastern"[MeSH Terms:noexp] OR "asia, western"[MeSH Terms:noexp] OR "caribbean region"[MeSH Terms:noexp] OR "west indies"[MeSH Terms:noexp] OR "south america"[MeSH Terms:noexp] OR "latin america"[MeSH Terms:noexp] OR "central america"[MeSH Terms:noexp] OR "afghanistan"[MeSH Terms:noexp] OR "albania"[MeSH Terms:noexp] OR "algeria"[MeSH Terms:noexp] OR "american samoa"[MeSH Terms:noexp] OR "angola"[MeSH Terms:noexp] OR "Antigua and Barbuda"[Mesh:noexp] OR "argentina"[MeSH Terms:noexp] OR "armenia"[MeSH Terms:noexp] OR "azerbaijan"[MeSH Terms:noexp] OR "bahrain"[MeSH Terms:noexp] OR "bangladesh"[MeSH Terms:noexp] OR "barbados"[MeSH Terms:noexp] OR "benin"[MeSH Terms:noexp] OR "republic of belarus"[MeSH Terms:noexp] OR "belize"[MeSH Terms:noexp] OR "bhutan"[MeSH Terms:noexp] OR "bolivia"[MeSH Terms:noexp] OR "bosnia and herzegovina"[MeSH Terms:noexp] OR "botswana"[MeSH Terms:noexp] OR "brazil"[MeSH Terms:noexp] OR "bulgaria"[MeSH Terms:noexp] OR "burkina faso"[MeSH Terms:noexp] OR "burundi"[MeSH Terms:noexp] OR "cambodia"[MeSH Terms:noexp] OR "cameroon"[MeSH Terms:noexp] OR "cabo verde"[MeSH Terms:noexp] OR "central african republic"[MeSH Terms:noexp] OR "chad"[MeSH Terms:noexp] OR "chile"[MeSH Terms:noexp] OR "china"[MeSH Terms:noexp] OR "colombia"[MeSH Terms:noexp] OR "comoros"[MeSH Terms:noexp] OR "congo"[MeSH Terms:noexp] OR "costa rica"[MeSH Terms:noexp] OR "cote d'ivoire"[MeSH Terms:noexp] OR "croatia"[MeSH Terms:noexp] OR "cuba"[MeSH Terms:noexp] OR "cyprus"[MeSH Terms:noexp] OR "czechoslovakia"[MeSH Terms:noexp] OR "czech republic"[MeSH Terms:noexp] OR "slovakia"[MeSH Terms:noexp] OR "djibouti"[MeSH Terms:noexp] OR "Democratic Republic of the Congo"[Mesh:noexp] OR "dominica"[MeSH Terms:noexp] OR "dominican republic"[MeSH Terms:noexp] OR "timor-leste"[MeSH Terms:noexp] OR "ecuador"[MeSH Terms:noexp] OR "egypt"[MeSH Terms:noexp] OR "el salvador"[MeSH Terms:noexp] OR "eritrea"[MeSH Terms:noexp] OR "estonia"[MeSH Terms:noexp] OR "ethiopia"[MeSH Terms:noexp] OR "fiji"[MeSH Terms:noexp] OR "gabon"[MeSH Terms:noexp] OR "gambia"[MeSH Terms:noexp] OR "Georgia (Republic)"[Mesh:noexp] OR "ghana"[MeSH Terms:noexp] OR "greece"[MeSH Terms:noexp] OR "grenada"[MeSH Terms:noexp] OR "guatemala"[MeSH Terms:noexp] OR "guinea"[MeSH Terms:noexp] OR "guinea-bissau"[MeSH

Terms:noexp] OR "guam"[MeSH Terms:noexp] OR "guyana"[MeSH Terms:noexp] OR "haiti"[MeSH Terms:noexp] OR "honduras"[MeSH Terms:noexp] OR "hungary"[MeSH Terms:noexp] OR "india"[MeSH Terms:noexp] OR "indonesia"[MeSH Terms:noexp] OR "iran"[MeSH Terms:noexp] OR "iraq"[MeSH Terms:noexp] OR "jamaica"[MeSH Terms:noexp] OR "jordan"[MeSH Terms:noexp] OR "kazakhstan"[MeSH Terms:noexp] OR "kenya"[MeSH Terms:noexp] OR "korea"[MeSH Terms:noexp] OR "kosovo"[MeSH Terms:noexp] OR "kyrgyzstan"[MeSH Terms:noexp] OR "laos"[MeSH Terms:noexp] OR "latvia"[MeSH Terms:noexp] OR "lebanon"[MeSH Terms:noexp] OR "lesotho"[MeSH Terms:noexp] OR "liberia"[MeSH Terms:noexp] OR "libya"[MeSH Terms:noexp] OR "lithuania"[MeSH Terms:noexp] OR "macedonia (republic)"[MeSH Terms:noexp] OR "madagascar"[MeSH Terms:noexp] OR "malaysia"[MeSH Terms:noexp] OR "malawi"[MeSH Terms:noexp] OR "mali"[MeSH Terms:noexp] OR "malta"[MeSH Terms:noexp] OR "mauritania"[MeSH Terms:noexp] OR "mauritius"[MeSH Terms:noexp] OR "mexico"[MeSH Terms:noexp] OR "micronesia"[MeSH Terms:noexp] OR "middle east"[MeSH Terms:noexp] OR "moldova"[MeSH Terms:noexp] OR "mongolia"[MeSH Terms:noexp] OR "montenegro"[MeSH Terms:noexp] OR "morocco"[MeSH Terms:noexp] OR "mozambique"[MeSH Terms:noexp] OR "myanmar"[MeSH Terms:noexp] OR "namibia"[MeSH Terms:noexp] OR "nepal"[MeSH Terms:noexp] OR "netherlands antilles"[MeSH Terms:noexp] OR "new caledonia"[MeSH Terms:noexp] OR "nicaragua"[MeSH Terms:noexp] OR "niger"[MeSH Terms:noexp] OR "nigeria"[MeSH Terms:noexp] OR "oman"[MeSH Terms:noexp] OR "pakistan"[MeSH Terms:noexp] OR "palau"[MeSH Terms:noexp] OR "panama"[MeSH Terms:noexp] OR "papua new guinea"[MeSH Terms:noexp] OR "paraguay"[MeSH Terms:noexp] OR "peru"[MeSH Terms:noexp] OR "philippines"[MeSH Terms:noexp] OR "poland"[MeSH Terms:noexp] OR "portugal"[MeSH Terms:noexp] OR "puerto rico"[MeSH Terms:noexp] OR "romania"[MeSH Terms:noexp] OR "russia"[MeSH Terms:noexp] OR "Russia (Pre-1917)"[Mesh:noexp] OR "rwanda"[MeSH Terms:noexp] OR "Saint Kitts and Nevis"[Mesh:noexp] OR "saint lucia"[MeSH Terms:noexp] OR "Saint Vincent and the Grenadines"[Mesh:noexp] OR "samoa"[MeSH Terms:noexp] OR "saudi arabia"[MeSH Terms:noexp] OR "senegal"[MeSH Terms:noexp] OR "serbia"[MeSH Terms:noexp] OR "montenegro"[MeSH Terms:noexp] OR "seychelles"[MeSH Terms:noexp] OR "sierra leone"[MeSH Terms:noexp] OR "slovenia"[MeSH Terms:noexp] OR "sri lanka"[MeSH Terms:noexp] OR "somalia"[MeSH Terms:noexp] OR "south africa"[MeSH Terms:noexp] OR "sudan"[MeSH Terms:noexp] OR "suriname"[MeSH Terms:noexp] OR "swaziland"[MeSH Terms:noexp] OR "syria"[MeSH Terms:noexp] OR "tajikistan"[MeSH Terms:noexp] OR "tanzania"[MeSH Terms:noexp] OR "thailand"[MeSH Terms:noexp] OR "togo"[MeSH Terms:noexp] OR "tonga"[MeSH Terms:noexp] OR "Trinidad and Tobago"[Mesh:noexp] OR "tunisia"[MeSH Terms:noexp] OR "turkey"[MeSH Terms:noexp] OR "turkmenistan"[MeSH Terms:noexp] OR "uganda"[MeSH Terms:noexp] OR "ukraine"[MeSH Terms:noexp] OR "uruguay"[MeSH Terms:noexp] OR "ussr"[MeSH Terms:noexp] OR "uzbekistan"[MeSH Terms:noexp] OR "vanuatu"[MeSH Terms:noexp] OR "venezuela"[MeSH Terms:noexp] OR "vietnam"[MeSH Terms:noexp] OR "yemen"[MeSH Terms:noexp] OR "yugoslavia"[MeSH Terms:noexp] OR "zambia"[MeSH Terms:noexp] OR "zimbabwe"[MeSH Terms:noexp])) AND ("2008/01/01"[PDAT] : "2018/12/31"[PDAT])

All combined: 633 Results Total

((("Telemedicine"[Mesh] OR "Mobile Applications"[Mesh] OR "telemedicine"[tw] OR "telehealth"[tw] OR "digital health"[tw] OR "mobile"[tw] OR "Telephone"[Mesh] OR "phone"[tw] OR "phones"[tw] OR "telephone"[tw] OR "telephones"[tw] OR "smartphone"[tw] OR "smartphones"[tw] OR "iphone"[tw] OR "iphones"[tw] OR "android"[tw] OR "androids"[tw] OR "mHealth"[tw] OR "eHealth"[tw] OR "Information Technology"[Mesh] OR "information technology"[tw] OR "information technologies"[tw] OR "communication technology"[tw] OR "communication technologies"[tw] OR ("cellular "[tw] OR "wearable"[tiab] OR "digital"[tiab]) AND ("technology"[tw] OR "technologies"[tw])) OR ((cellular[tw] OR mobile[tw] OR phone[tw] OR smart[tw] OR text[tiab] OR digital[tiab] OR electronic[tiab] OR interactive[tiab] OR translation[tiab] OR software[tiab] OR tablet[tiab]) AND ("app"[tiab] OR "apps"[tiab] OR "application"[tiab] OR "applications"[tiab] OR alert[tiab] OR alerts[tiab] OR reminder[tiab] OR reminders[tiab])) OR "mobile device"[tw] OR "mobile devices"[tw] OR "SMS"[tw] OR "short message service"[tw] OR "text message"[tw] OR "text-message"[tw] OR "ipad"[tw] OR "text messages"[tw] OR "text-messages"[tw] OR "text messaging"[tw] OR "text-messaging"[tw] OR "texting"[tw] OR "interactive voice response"[tw]) AND ("2008/01/01"[PDAT] : "2018/12/31"[PDAT])) AND (("community health workers"[MeSH Terms] OR "community health worker"[tw] OR "community health workers"[tw] OR ("community health"[tiab] OR "village health"[tiab]) AND ("worker"[tiab] OR "workers"[tiab] OR "staff"[tiab] OR "staffing"[tiab] OR "personnel"[tiab] OR "agent"[tiab] OR "agents"[tiab] OR "volunteer"[tiab] OR

"volunteers"[tiab] OR "aide"[tiab] OR "aides"[tiab] OR "auxiliary"[tiab] OR "auxiliaries"[tiab] OR "helper"[tiab] OR "helpers"[tiab]) OR "CHW"[tw] OR "CHWs"[tw] OR "community health aide"[tw] OR "community health aides"[tw] OR "family planning personnel"[tw] OR "midwifery"[MeSH Terms] OR "traditional birth attendant"[tw] OR "traditional birth attendants"[tw] OR "skilled birth attendant"[tw] OR "skilled birth attendants"[tw] OR "frontline worker"[tw] OR "frontline workers"[tw] OR "health worker"[tw] OR "health workers"[tw] OR "lay worker"[tw] OR "lay workers"[All Fields] OR "village health worker"[tw] OR "village health workers"[tw] OR "VHW"[tw] OR "VHWs"[tw] OR "midwife"[tw] OR "midwives"[tw] OR "barefoot doctors"[tw] OR "barefoot doctor"[tw] OR "health auxiliary"[tw] OR "health auxiliaries"[tw] OR "peer health worker"[tw] OR "peer health workers"[tw] OR "medical auxiliary"[tw] OR "medical auxiliaries"[tw] OR "health provider"[tw] OR "health providers"[tw] OR "lay counselor"[tw] OR "lay counselors"[tw] OR "lady health worker"[tw] OR "lady health workers"[tw] OR "LHW"[tw] OR "LHWs"[tw] OR "lay educator"[tw] OR "lay educators"[tw] OR "agentes comunitarios de salud"[tw] OR "Anganwadi"[tw] OR "accredited social health activist"[tw] OR "accredited social health activists"[tw] OR "ASHA"[tw] OR "ASHAs"[tw] OR "Barangay Health Workers"[tw] OR "Basic health worker"[tw] OR "basic health workers"[tw] OR "Brigadista"[tw] OR "brigadistas"[tw] OR "community drug distributors"[tw] OR "Community health agent"[tw] OR "community health agents"[tw] OR "Community health promoter"[tw] OR "community health promoters"[tw] OR "Community health representative"[tw] OR "community health representatives"[tw] OR "Community health volunteer"[tw] OR "community health volunteers"[tw] OR "community nutrition workers"[tw] OR "community resource persons"[tw] OR "Female community health volunteer"[tw] OR "female community health volunteers"[tw] OR "Health promoter"[tw] OR "health promoters"[tw] OR "Kader"[tw] OR "kaders"[tw] OR "mother coordinators"[tw] OR "outreach educators"[tw] OR "Promotora"[tw] OR "Promotoras"[tw] OR "Sevika"[tw] OR "village health helpers"[tw] OR "Raedat"[tw] OR "Accompagnateurs"[tw] OR "Accompagnateur"[tw] OR "Behvarz"[tw] OR "Dai"[tw] OR "Dais"[tw] OR "bidan kampungs"[tw] AND ("2008/01/01"[PDAT] : "2018/12/31"[PDAT])) AND (((("developing country"[tw] OR "developing countries"[tw] OR "developing nation"[tw] OR "developing nations"[tw] OR "developing population"[tw] OR "developing populations"[tw] OR "developing world"[tw] OR "less developed country"[tw] OR "less developed countries"[tw] OR "less developed nation"[tw] OR "less developed nations"[tw] OR "less developed world"[tw] OR "lesser developed countries"[tw] OR "lesser developed nations"[tw] OR "under developed country"[tw] OR "under developed countries"[tw] OR "under developed nations"[tw] OR "under developed world"[tw] OR "underdeveloped country"[tw] OR "underdeveloped countries"[tw] OR "underdeveloped nations"[tw] OR "underdeveloped population"[tw] OR "underdeveloped world"[tw] OR "middle income country"[tw] OR "middle income countries"[tw] OR "middle income nation"[tw] OR "middle income nations"[tw] OR "middle income population"[tw] OR "middle income populations"[tw] OR "low income country"[tw] OR "low income countries"[tw] OR "low income nation"[tw] OR "low income nations"[tw] OR "low income population"[tw] OR "low income populations"[tw] OR "lower income country"[tw] OR "lower income countries"[tw] OR "lower income nations"[tw] OR "lower income population"[tw] OR "lower income populations"[tw] OR "underserved countries"[tw] OR "underserved nations"[tw] OR "underserved population"[tw] OR "underserved populations"[tw] OR "under served population"[tw] OR "under served populations"[tw] OR "deprived countries"[tw] OR "deprived population"[tw] OR "deprived populations"[tw] OR "poor country"[tw] OR "poor countries"[tw] OR "poor nation"[tw] OR "poor nations"[tw] OR "poor population"[tw] OR "poor populations"[tw] OR "poor world"[tw] OR "poorer countries"[tw] OR "poorer nations"[tw] OR "poorer population"[tw] OR "poorer populations"[tw] OR "developing economy"[tw] OR "developing economies"[tw] OR "less developed economy"[tw] OR "less developed economies"[tw] OR "underdeveloped economies"[tw] OR "middle income economies"[tw] OR "low income economy"[tw] OR "low income economies"[tw] OR "low gdp"[tw] OR "low gnp"[tw] OR "low gross domestic"[tw] OR "low gross national"[tw] OR "lower gdp"[tw] OR "lower gross domestic"[tw] OR "lami country"[tw] OR "lami countries"[tw] OR "transitional country"[tw] OR "transitional countries"[tw]) OR (Africa[tw] OR Asia[tw] OR Caribbean[tw] OR West Indies[tw] OR South America[tw] OR Latin America[tw] OR Central America[tw] OR Afghanistan[tw] OR Albania[tw] OR Algeria[tw] OR Angola[tw] OR Antigua[tw] OR Barbuda[tw] OR Argentina[tw] OR Armenia[tw] OR Armenian[tw] OR Aruba[tw] OR Azerbaijan[tw] OR Bahrain[tw] OR Bangladesh[tw] OR Barbados[tw] OR Benin[tw] OR Byelarus[tw] OR Byelorussian[tw] OR Belarus[tw] OR Belorussian[tw] OR Belorussia[tw] OR Belize[tw] OR Bhutan[tw] OR Bolivia[tw] OR Bosnia[tw] OR Herzegovina[tw] OR Hercegovina[tw] OR Botswana[tw] OR Brasil[tw] OR Brazil[tw] OR Bulgaria[tw] OR Burkina Faso[tw] OR Burkina Fasso[tw] OR Upper Volta[tw] OR Burundi[tw] OR Urundi[tw] OR Cambodia[tw] OR Khmer Republic[tw] OR Kampuchea[tw]

OR Cameroon[tw] OR Camerouns[tw] OR Cameron[tw] OR Cape Verde[tw] OR Central African Republic[tw] OR Chad[tw] OR Chile[tw] OR China[tw] OR Colombia[tw] OR Comoros[tw] OR Comoro Islands[tw] OR Comores[tw] OR Mayotte[tw] OR Congo[tw] OR Zaire[tw] OR Costa Rica[tw] OR Cote d'Ivoire[tw] OR Ivory Coast[tw] OR Croatia[tw] OR Cuba[tw] OR Cyprus[tw] OR Czechoslovakia[tw] OR Czech Republic[tw] OR Slovakia[tw] OR Slovak Republic[tw] OR Djibouti[tw] OR French Somaliland[tw] OR Dominica[tw] OR Dominican Republic[tw] OR East Timor[tw] OR (East[All Fields] AND Timur[tw]) OR Timor Leste[tw] OR Ecuador[tw] OR Egypt[tw] OR United Arab Republic[tw] OR El Salvador[tw] OR Eritrea[tw] OR Estonia[tw] OR Ethiopia[tw] OR Fiji[tw] OR Gabon[tw] OR Gabonese Republic[tw] OR Gambia[tw] OR Gaza[tw] OR Georgia Republic[tw] OR Georgian Republic[tw] OR Ghana[tw] OR Gold Coast[tw] OR Greece[tw] OR Grenada[tw] OR Guatemala[tw] OR Guinea[tw] OR Guam[tw] OR Guiana[tw] OR Guyana[tw] OR Haiti[tw] OR Honduras[tw] OR Hungary[tw] OR India[tw] OR Maldives[tw] OR Indonesia[tw] OR Iran[tw] OR Iraq[tw] OR Isle of Man[tw] OR Jamaica[tw] OR Jordan[tw] OR Kazakhstan[tw] OR Kazakh[tw] OR Kenya[tw] OR Kiribati[tw] OR Korea[tw] OR Kosovo[tw] OR Kyrgyzstan[tw] OR Kirghizia[tw] OR Kyrgyz Republic[tw] OR Kirghiz[tw] OR Kirgizstan[tw] OR "Lao PDR"[tw] OR Laos[tw] OR Latvia[tw] OR Lebanon[tw] OR Lesotho[tw] OR Basutoland[tw] OR Liberia[tw] OR Libya[tw] OR Lithuania[tw]) OR (Macedonia[tw] OR Madagascar[tw] OR Malagasy Republic[tw] OR Malaysia[tw] OR Malay[tw] OR Malay[tw] OR Sabah[tw] OR Sarawak[tw] OR Sarawak[tw] OR Malawi[tw] OR Nyasaland[tw] OR Mali[tw] OR Malta[tw] OR Marshall Islands[tw] OR Mauritania[tw] OR Mauritius[tw] OR Agalega Islands[tw] OR Mexico[tw] OR Micronesia[tw] OR Middle East[tw] OR Moldova[tw] OR Moldovia[tw] OR Moldovian[tw] OR Mongolia[tw] OR Montenegro[tw] OR Morocco[tw] OR Ifni[tw] OR Mozambique[tw] OR Myanmar[tw] OR Myanma[tw] OR Burma[tw] OR Namibia[tw] OR Nepal[tw] OR Netherlands Antilles[tw] OR New Caledonia[tw] OR Nicaragua[tw] OR Niger[tw] OR Nigeria[tw] OR Northern Mariana Islands[tw] OR Oman[tw] OR Muscat[tw] OR Pakistan[tw] OR Palau[tw] OR Palestine[tw] OR Panama[tw] OR Paraguay[tw] OR Peru[tw] OR Philippines[tw] OR Philipines[tw] OR Phillipines[tw] OR Phillippines[tw] OR Poland[tw] OR Portugal[tw] OR Puerto Rico[tw] OR Romania[tw] OR Rumania[tw] OR Roumania[tw] OR Russia[tw] OR Russian[tw] OR Rwanda[tw] OR Ruanda[tw] OR Saint Kitts[tw] OR St Kitts[tw] OR Nevis[tw] OR Saint Lucia[tw] OR St Lucia[tw] OR Saint Vincent[tw] OR St Vincent[tw] OR Grenadines[tw] OR Samoa[tw] OR Samoan Islands[tw] OR (Navigator[All Fields] AND Island[tw]) OR (Navigator[All Fields] AND Islands[tw]) OR Sao Tome[tw] OR Saudi Arabia[tw] OR Senegal[tw] OR Serbia[tw] OR Montenegro[tw] OR Seychelles[tw] OR Sierra Leone[tw] OR Slovenia[tw] OR Sri Lanka[tw] OR Ceylon[tw] OR Solomon Islands[tw] OR Somalia[tw] OR Sudan[tw] OR Suriname[tw] OR Surinam[tw] OR Swaziland[tw] OR Syria[tw] OR Tajikistan[tw] OR Tadjikistan[tw] OR Tadjikistan[tw] OR Tadjik[tw] OR Tanzania[tw] OR Thailand[tw] OR Togo[tw] OR Togolese Republic[tw] OR Tonga[tw] OR Trinidad[tw] OR Tobago[tw] OR Tunisia[tw] OR Turkey[tw] OR Turkmenistan[tw] OR Turkmen[tw] OR Uganda[tw] OR Ukraine[tw] OR Uruguay[tw] OR USSR[tw] OR Soviet Union[tw] OR Union of Soviet Socialist Republics[tw] OR Uzbekistan[tw] OR Uzbek[All Fields] OR Vanuatu[tw] OR New Hebrides[tw] OR Venezuela[tw] OR Vietnam[tw] OR Viet Nam[tw] OR West Bank[tw] OR Yemen[tw] OR Yugoslavia[tw] OR Zambia[tw] OR Zimbabwe[tw] OR Rhodesia[tw])) OR ("developing countries"[MeSH Terms:noexp] OR "africa"[MeSH Terms:noexp] OR "africa, northern"[MeSH Terms:noexp] OR "africa south of the sahara"[MeSH Terms:noexp] OR "africa, central"[MeSH Terms:noexp] OR "africa, eastern"[MeSH Terms:noexp] OR "africa, southern"[MeSH Terms:noexp] OR "africa, western"[MeSH Terms:noexp] OR "asia"[MeSH Terms:noexp] OR "asia, central"[MeSH Terms:noexp] OR "asia, southeastern"[MeSH Terms:noexp] OR "asia, western"[MeSH Terms:noexp] OR "caribbean region"[MeSH Terms:noexp] OR "west indies"[MeSH Terms:noexp] OR "south america"[MeSH Terms:noexp] OR "latin america"[MeSH Terms:noexp] OR "central america"[MeSH Terms:noexp] OR "afghanistan"[MeSH Terms:noexp] OR "albania"[MeSH Terms:noexp] OR "algeria"[MeSH Terms:noexp] OR "american samoa"[MeSH Terms:noexp] OR "angola"[MeSH Terms:noexp] OR "Antigua and Barbuda"[Mesh:noexp] OR "argentina"[MeSH Terms:noexp] OR "armenia"[MeSH Terms:noexp] OR "azerbaijan"[MeSH Terms:noexp] OR "bahrain"[MeSH Terms:noexp] OR "bangladesh"[MeSH Terms:noexp] OR "barbados"[MeSH Terms:noexp] OR "benin"[MeSH Terms:noexp] OR "republic of belarus"[MeSH Terms:noexp] OR "belize"[MeSH Terms:noexp] OR "bhutan"[MeSH Terms:noexp] OR "bolivia"[MeSH Terms:noexp] OR "bosnia and herzegovina"[MeSH Terms:noexp] OR "botswana"[MeSH Terms:noexp] OR "brazil"[MeSH Terms:noexp] OR "bulgaria"[MeSH Terms:noexp] OR "burkina faso"[MeSH Terms:noexp] OR "burundi"[MeSH Terms:noexp] OR "cambodia"[MeSH Terms:noexp] OR "cameroon"[MeSH Terms:noexp] OR "cabo verde"[MeSH Terms:noexp] OR "central african republic"[MeSH Terms:noexp] OR "chad"[MeSH Terms:noexp] OR "chile"[MeSH Terms:noexp] OR

"china"[MeSH Terms:noexp] OR "colombia"[MeSH Terms:noexp] OR "comoros"[MeSH Terms:noexp] OR "congo"[MeSH Terms:noexp] OR "costa rica"[MeSH Terms:noexp] OR "cote d'ivoire"[MeSH Terms:noexp] OR "croatia"[MeSH Terms:noexp] OR "cuba"[MeSH Terms:noexp] OR "cyprus"[MeSH Terms:noexp] OR "czechoslovakia"[MeSH Terms:noexp] OR "czech republic"[MeSH Terms:noexp] OR "slovakia"[MeSH Terms:noexp] OR "djibouti"[MeSH Terms:noexp] OR "Democratic Republic of the Congo"[Mesh:noexp] OR "dominica"[MeSH Terms:noexp] OR "dominican republic"[MeSH Terms:noexp] OR "timor-leste"[MeSH Terms:noexp] OR "ecuador"[MeSH Terms:noexp] OR "egypt"[MeSH Terms:noexp] OR "el salvador"[MeSH Terms:noexp] OR "eritrea"[MeSH Terms:noexp] OR "estonia"[MeSH Terms:noexp] OR "ethiopia"[MeSH Terms:noexp] OR "fiji"[MeSH Terms:noexp] OR "gabon"[MeSH Terms:noexp] OR "gambia"[MeSH Terms:noexp] OR "Georgia (Republic)"[Mesh:noexp] OR "ghana"[MeSH Terms:noexp] OR "greece"[MeSH Terms:noexp] OR "grenada"[MeSH Terms:noexp] OR "guatemala"[MeSH Terms:noexp] OR "guinea"[MeSH Terms:noexp] OR "guinea-bissau"[MeSH Terms:noexp] OR "guam"[MeSH Terms:noexp] OR "guyana"[MeSH Terms:noexp] OR "haiti"[MeSH Terms:noexp] OR "honduras"[MeSH Terms:noexp] OR "hungary"[MeSH Terms:noexp] OR "india"[MeSH Terms:noexp] OR "indonesia"[MeSH Terms:noexp] OR "iran"[MeSH Terms:noexp] OR "iraq"[MeSH Terms:noexp] OR "jamaica"[MeSH Terms:noexp] OR "jordan"[MeSH Terms:noexp] OR "kazakhstan"[MeSH Terms:noexp] OR "kenya"[MeSH Terms:noexp] OR "korea"[MeSH Terms:noexp] OR "kosovo"[MeSH Terms:noexp] OR "kyrgyzstan"[MeSH Terms:noexp] OR "laos"[MeSH Terms:noexp] OR "latvia"[MeSH Terms:noexp] OR "lebanon"[MeSH Terms:noexp] OR "lesotho"[MeSH Terms:noexp] OR "liberia"[MeSH Terms:noexp] OR "libya"[MeSH Terms:noexp] OR "lithuania"[MeSH Terms:noexp] OR "macedonia (republic)"[MeSH Terms:noexp] OR "madagascar"[MeSH Terms:noexp] OR "malaysia"[MeSH Terms:noexp] OR "malawi"[MeSH Terms:noexp] OR "mali"[MeSH Terms:noexp] OR "malta"[MeSH Terms:noexp] OR "mauritania"[MeSH Terms:noexp] OR "mauritius"[MeSH Terms:noexp] OR "mexico"[MeSH Terms:noexp] OR "micronesia"[MeSH Terms:noexp] OR "middle east"[MeSH Terms:noexp] OR "moldova"[MeSH Terms:noexp] OR "mongolia"[MeSH Terms:noexp] OR "montenegro"[MeSH Terms:noexp] OR "morocco"[MeSH Terms:noexp] OR "mozambique"[MeSH Terms:noexp] OR "myanmar"[MeSH Terms:noexp] OR "namibia"[MeSH Terms:noexp] OR "nepal"[MeSH Terms:noexp] OR "netherlands antilles"[MeSH Terms:noexp] OR "new caledonia"[MeSH Terms:noexp] OR "nicaragua"[MeSH Terms:noexp] OR "niger"[MeSH Terms:noexp] OR "nigeria"[MeSH Terms:noexp] OR "oman"[MeSH Terms:noexp] OR "pakistan"[MeSH Terms:noexp] OR "palau"[MeSH Terms:noexp] OR "panama"[MeSH Terms:noexp] OR "papua new guinea"[MeSH Terms:noexp] OR "paraguay"[MeSH Terms:noexp] OR "peru"[MeSH Terms:noexp] OR "philippines"[MeSH Terms:noexp] OR "poland"[MeSH Terms:noexp] OR "portugal"[MeSH Terms:noexp] OR "puerto rico"[MeSH Terms:noexp] OR "romania"[MeSH Terms:noexp] OR "russia"[MeSH Terms:noexp] OR "Russia (Pre-1917)"[Mesh:noexp] OR "rwanda"[MeSH Terms:noexp] OR "Saint Kitts and Nevis"[Mesh:noexp] OR "saint lucia"[MeSH Terms:noexp] OR "Saint Vincent and the Grenadines"[Mesh:noexp] OR "samoa"[MeSH Terms:noexp] OR "saudi arabia"[MeSH Terms:noexp] OR "senegal"[MeSH Terms:noexp] OR "serbia"[MeSH Terms:noexp] OR "montenegro"[MeSH Terms:noexp] OR "seychelles"[MeSH Terms:noexp] OR "sierra leone"[MeSH Terms:noexp] OR "slovenia"[MeSH Terms:noexp] OR "sri lanka"[MeSH Terms:noexp] OR "somalia"[MeSH Terms:noexp] OR "south africa"[MeSH Terms:noexp] OR "sudan"[MeSH Terms:noexp] OR "suriname"[MeSH Terms:noexp] OR "swaziland"[MeSH Terms:noexp] OR "syria"[MeSH Terms:noexp] OR "tajikistan"[MeSH Terms:noexp] OR "tanzania"[MeSH Terms:noexp] OR "thailand"[MeSH Terms:noexp] OR "togo"[MeSH Terms:noexp] OR "tonga"[MeSH Terms:noexp] OR "Trinidad and Tobago"[Mesh:noexp] OR "tunisia"[MeSH Terms:noexp] OR "turkey"[MeSH Terms:noexp] OR "turkmenistan"[MeSH Terms:noexp] OR "uganda"[MeSH Terms:noexp] OR "ukraine"[MeSH Terms:noexp] OR "uruguay"[MeSH Terms:noexp] OR "ussr"[MeSH Terms:noexp] OR "uzbekistan"[MeSH Terms:noexp] OR "vanuatu"[MeSH Terms:noexp] OR "venezuela"[MeSH Terms:noexp] OR "vietnam"[MeSH Terms:noexp] OR "yemen"[MeSH Terms:noexp] OR "yugoslavia"[MeSH Terms:noexp] OR "zambia"[MeSH Terms:noexp] OR "zimbabwe"[MeSH Terms:noexp])) AND ("2008/01/01"[PDAT] : "2018/12/31"[PDAT]))

Embase 4/3/2018

Concept 1: mHealth 200,105

('mobile health'/exp OR 'mobile application'/exp OR 'mobile health':ab,ti,kw OR 'mhealth'/exp OR 'mhealth':ab,ti,kw OR 'telemedicine':ab,ti,kw OR 'telehealth'/exp OR 'telehealth':ab,ti,kw OR 'digital health'/exp OR 'digital health':ab,ti,kw OR 'phone':ab,ti,kw OR 'phones':ab,ti,kw OR 'mobile phone'/exp

OR 'mobile phone':ab,ti,kw OR 'mobile phones':ab,ti,kw OR 'telephone'/exp OR 'telephone':ab,ti,kw OR 'telephones':ab,ti,kw OR 'smartphone'/exp OR 'smartphone':ab,ti,kw OR 'smartphones':ab,ti,kw OR 'iphone':ab,ti,kw OR 'iphones':ab,ti,kw OR 'android':ab,ti,kw OR 'androids':ab,ti,kw OR 'ehealth':ab,ti,kw OR 'information technology'/exp OR 'information technology':ab,ti,kw OR 'information technologies':ab,ti,kw OR 'communication technology':ab,ti,kw OR 'communication technologies':ab,ti,kw OR (('cellular':ab,ti,kw OR 'wearable':ab,ti OR 'digital':ab,ti) AND ('technology':ab,ti,kw OR 'technologies':ab,ti,kw)) OR (('cellular':ab,ti,kw OR 'mobile':ab,ti,kw OR 'phone':ab,ti,kw OR 'smart':ab,ti,kw OR 'text':ab,ti OR 'digital':ab,ti OR 'electronic':ab,ti OR 'interactive':ab,ti OR 'translation':ab,ti OR 'software':ab,ti OR 'tablet':ab,ti) AND ('app':ab,ti OR 'apps':ab,ti OR 'application':ab,ti OR 'applicatons':ab,ti OR 'alert':ab,ti OR 'alerts':ab,ti OR 'reminder':ab,ti OR 'reminders':ab,ti)) OR 'mobile device':ab,ti,kw OR 'mobile devices':ab,ti,kw OR 'SMS':ab,ti,kw OR 'short message services':ab,ti,kw OR 'text message'/exp OR 'text message':ab,ti,kw OR 'ipad':ab,ti,kw OR 'text-message':ab,ti,kw OR 'text messages':ab,ti,kw OR 'text-messages':ab,ti,kw OR 'text messaging':ab,ti,kw OR 'text-messaging':ab,ti,kw OR 'texting':ab,ti,kw OR 'textings':ab,ti,kw OR 'text contact':ab,ti,kw OR 'text contacts':ab,ti,kw OR 'interactive voice response':ab,ti,kw) AND (2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py OR 2016:py OR 2017:py OR 2018:py)

Concept 2: Health worker 39,206 results

('health auxiliary'/exp OR 'health auxiliary':ab,ti,kw OR 'community health worker':ab,ti,kw OR 'community health workers':ab,ti,kw OR (('community health':ab,ti OR 'village health':ab,ti) AND ('worker':ab,ti OR 'workers':ab,ti OR 'staff':ab,ti OR 'staffing':ab,ti OR 'personnel':ab,ti OR 'agent':ab,ti OR 'agents':ab,ti OR 'volunteer':ab,ti OR 'volunteers':ab,ti OR 'aide':ab,ti OR 'aides':ab,ti OR 'auxiliary':ab,ti OR 'auxiliaries':ab,ti OR 'helper':ab,ti OR 'helpers':ab,ti)) OR 'CHW':ab,ti,kw OR 'CHWs':ab,ti,kw OR 'frontline worker':ab,ti,kw OR 'frontline workers':ab,ti,kw OR 'community health aide':ab,ti,kw OR 'community health aides':ab,ti,kw OR 'family planning personnel'/exp OR 'family planning personnel':ab,ti,kw OR 'midwife'/exp OR 'traditional birth attendant'/exp OR 'traditional birth attendant':ab,ti,kw OR 'traditional birth attendants':ab,ti,kw OR 'skilled birth attendant':ab,ti,kw OR 'skilled birth attendants':ab,ti,kw OR 'health worker':ab,ti,kw OR 'health workers':ab,ti,kw OR 'lay worker':ab,ti,kw OR 'lay workers':ab,ti,kw OR 'village health worker':ab,ti,kw OR 'village health workers':ab,ti,kw OR 'VHW':ab,ti,kw OR 'VHWs':ab,ti,kw OR 'midwife':ab,ti,kw OR 'midwives':ab,ti,kw OR 'barefoot doctors':ab,ti,kw OR 'barefoot doctor':ab,ti,kw OR 'health auxiliary':ab,ti,kw OR 'health auxiliaries':ab,ti,kw OR 'peer health worker':ab,ti,kw OR 'peer health workers':ab,ti,kw OR 'medical auxiliary':ab,ti,kw OR 'medical auxiliaries':ab,ti,kw OR 'health provider':ab,ti,kw OR 'health providers':ab,ti,kw OR 'lay counselor':ab,ti,kw OR 'lay counselors':ab,ti,kw OR 'lady health worker':ab,ti,kw OR 'lady health workers':ab,ti,kw OR 'LHW':ab,ti,kw OR 'LHWs':ab,ti,kw OR 'lay educator':ab,ti,kw OR 'lay educators':ab,ti,kw OR 'Activista':ab,ti,kw OR 'activistas':ab,ti,kw OR 'Agente comunitario de salud':ab,ti,kw OR 'agentes comunitarios de salud':ab,ti,kw OR 'Anganwadi':ab,ti,kw OR 'accredited social health activist':ab,ti,kw OR 'accredited social health activists':ab,ti,kw OR 'ASHA':ab,ti,kw OR 'ASHAs':ab,ti,kw OR 'Animatrice':ab,ti,kw OR 'animatrices':ab,ti,kw OR 'Barangay health worker':ab,ti,kw OR 'Barangay Health Workers':ab,ti,kw OR 'Basic health worker':ab,ti,kw OR 'basic health workers':ab,ti,kw OR 'Brigadista':ab,ti,kw OR 'brigadistas':ab,ti,kw OR 'Colaborador voluntario':ab,ti,kw OR 'Colaboradores voluntarios':ab,ti,kw OR 'Community drug distributor':ab,ti,kw OR 'community drug distributors':ab,ti,kw OR 'Community health agent':ab,ti,kw OR 'community health agents':ab,ti,kw OR 'Community health promoter':ab,ti,kw OR 'community health promoters':ab,ti,kw OR 'Community health representative':ab,ti,kw OR 'community health representatives':ab,ti,kw OR 'Community health volunteer':ab,ti,kw OR 'community health volunteers':ab,ti,kw OR 'Community nutrition worker':ab,ti,kw OR 'community nutrition workers':ab,ti,kw OR 'community nutrition volunteer':ab,ti,kw OR 'community nutrition volunteers':ab,ti,kw OR 'Community resource person':ab,ti,kw OR 'community resource persons':ab,ti,kw OR 'Female community health volunteer':ab,ti,kw OR 'female community health volunteers':ab,ti,kw OR 'Female multipurpose health worker':ab,ti,kw OR 'female multipurpose health workers':ab,ti,kw OR 'Health promoter':ab,ti,kw OR 'health promoters':ab,ti,kw OR 'Kader':ab,ti,kw OR 'kaders':ab,ti,kw OR 'Maternal and child health worker':ab,ti,kw OR 'maternal and child health workers':ab,ti,kw OR 'Monitora':ab,ti,kw OR 'monitoras':ab,ti,kw OR 'Mother coordinator':ab,ti,kw OR 'mother coordinators':ab,ti,kw OR 'Outreach educator':ab,ti,kw OR 'outreach educators':ab,ti,kw OR 'Promotora':ab,ti,kw OR 'Promotoras':ab,ti,kw OR 'Rural health motivator':ab,ti,kw OR 'rural health motivators':ab,ti,kw OR 'Shastho shebika':ab,ti,kw OR 'Shasthya Shebika':ab,ti,kw OR 'Shasthya Shebikas':ab,ti,kw OR 'Sevika':ab,ti,kw OR 'sevikas':ab,ti,kw OR 'Village health helper':ab,ti,kw OR 'village health helpers':ab,ti,kw OR 'Village drug-kit

manager':ab,ti,kw OR 'village drug-kit managers':ab,ti,kw OR 'Saksham Sahaya':ab,ti,kw OR 'Saksham Sahayaks':ab,ti,kw OR 'Raedat':ab,ti,kw OR 'Raedat Refiat':ab,ti,kw OR 'Accompagnateurs':ab,ti,kw OR 'Accompagnateur':ab,ti,kw OR 'Behvarz':ab,ti,kw OR 'behvarzan':ab,ti,kw OR 'Dai':ab,ti,kw OR 'Dais':ab,ti,kw OR 'Bidan Kampong':ab,ti,kw OR 'bidan kampungs':ab,ti,kw OR 'bidan kampong':ab,ti,kw OR 'agents de santé':ab,ti,kw OR 'agent de santé':ab,ti,kw) AND (2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py OR 2016:py OR 2017:py OR 2018:py)

Concept 3:LMIC 1,073,934 Results

('developing country':ti,ab,kw OR 'developing countries':ti,ab,kw OR 'developing nation':ti,ab,kw OR 'developing nations':ti,ab,kw OR 'developing population':ti,ab,kw OR 'developing populations':ti,ab,kw OR 'developing world':ti,ab,kw OR 'less developed country':ti,ab,kw OR 'less developed countries':ti,ab,kw OR 'less developed nation':ti,ab,kw OR 'less developed nations':ti,ab,kw OR 'less developed world':ti,ab,kw OR 'lesser developed countries':ti,ab,kw OR 'lesser developed nations':ti,ab,kw OR 'under developed country':ti,ab,kw OR 'under developed countries':ti,ab,kw OR 'under developed nations':ti,ab,kw OR 'under developed world':ti,ab,kw OR 'underdeveloped country':ti,ab,kw OR 'underdeveloped countries':ti,ab,kw OR 'underdeveloped population':ti,ab,kw OR 'underdeveloped world':ti,ab,kw OR 'middle income country':ti,ab,kw OR 'middle income countries':ti,ab,kw OR 'middle income nation':ti,ab,kw OR 'middle income nations':ti,ab,kw OR 'middle income population':ti,ab,kw OR 'middle income populations':ti,ab,kw OR 'low income country':ti,ab,kw OR 'low income countries':ti,ab,kw OR 'low income nation':ti,ab,kw OR 'low income nations':ti,ab,kw OR 'low income population':ti,ab,kw OR 'low income populations':ti,ab,kw OR 'lower income country':ti,ab,kw OR 'lower income countries':ti,ab,kw OR 'lower income nations':ti,ab,kw OR 'lower income population':ti,ab,kw OR 'lower income populations':ti,ab,kw OR 'underserved countries':ti,ab,kw OR 'underserved nations':ti,ab,kw OR 'underserved population':ti,ab,kw OR 'underserved populations':ti,ab,kw OR 'under served population':ti,ab,kw OR 'under served populations':ti,ab,kw OR 'deprived countries':ti,ab,kw OR 'deprived population':ti,ab,kw OR 'deprived populations':ti,ab,kw OR 'poor country':ti,ab,kw OR 'poor countries':ti,ab,kw OR 'poor nation':ti,ab,kw OR 'poor nations':ti,ab,kw OR 'poor population':ti,ab,kw OR 'poor populations':ti,ab,kw OR 'poor world':ti,ab,kw OR 'poorer countries':ti,ab,kw OR 'poorer nations':ti,ab,kw OR 'poorer population':ti,ab,kw OR 'poorer populations':ti,ab,kw OR 'developing economy':ti,ab,kw OR 'developing economies':ti,ab,kw OR 'less developed economy':ti,ab,kw OR 'less developed economies':ti,ab,kw OR 'underdeveloped economies':ti,ab,kw OR 'middle income economies':ti,ab,kw OR 'low income economy':ti,ab,kw OR 'low income economies':ti,ab,kw OR 'low gdp':ti,ab,kw OR 'low gnp':ti,ab,kw OR 'low gross domestic':ti,ab,kw OR 'low gross national':ti,ab,kw OR 'lower gdp':ti,ab,kw OR 'lower gross domestic':ti,ab,kw OR 'lami':ti,ab,kw OR 'lami countries':ti,ab,kw OR 'lami nations':ti,ab,kw OR 'lami population':ti,ab,kw OR 'lami populations':ti,ab,kw OR 'lami world':ti,ab,kw OR 'lami country':ti,ab,kw OR 'lami countries':ti,ab,kw OR 'transitional country':ti,ab,kw OR 'transitional countries':ti,ab,kw) OR (africa:ti,ab,kw OR asia:ti,ab,kw OR 'caribbean':ti,ab,kw OR 'west indies':ti,ab,kw OR 'south america':ti,ab,kw OR 'latin america':ti,ab,kw OR 'central america':ti,ab,kw OR 'afghanistan':ti,ab,kw OR 'albania':ti,ab,kw OR 'algeria':ti,ab,kw OR 'angola':ti,ab,kw OR 'antigua':ti,ab,kw OR 'barbuda':ti,ab,kw OR 'argentina':ti,ab,kw OR 'armenia':ti,ab,kw OR 'armenian':ti,ab,kw OR 'aruba':ti,ab,kw OR 'azerbaijan':ti,ab,kw OR 'bahrain':ti,ab,kw OR 'bangladesh':ti,ab,kw OR 'barbados':ti,ab,kw OR 'benin':ti,ab,kw OR 'byelarus':ti,ab,kw OR 'byelorussian':ti,ab,kw OR 'belarus':ti,ab,kw OR 'belorussian':ti,ab,kw OR 'belorussia':ti,ab,kw OR 'belize':ti,ab,kw OR 'bhutan':ti,ab,kw OR 'bolivia':ti,ab,kw OR 'bosnia':ti,ab,kw OR 'herzegovina':ti,ab,kw OR 'hercegovina':ti,ab,kw OR 'botswana':ti,ab,kw OR 'brasil':ti,ab,kw OR 'brazil':ti,ab,kw OR 'bulgaria':ti,ab,kw OR 'burkina faso':ti,ab,kw OR 'burkina fasso':ti,ab,kw OR 'upper volta':ti,ab,kw OR 'burundi':ti,ab,kw OR 'urundi':ti,ab,kw OR 'cambodia':ti,ab,kw OR 'khmer republic':ti,ab,kw OR 'kampuchea':ti,ab,kw OR 'cameroon':ti,ab,kw OR 'cameroons':ti,ab,kw OR 'cameron':ti,ab,kw OR 'cape verde':ti,ab,kw OR 'central african republic':ti,ab,kw OR 'chad':ti,ab,kw OR 'chile':ti,ab,kw OR 'china':ti,ab,kw OR 'colombia':ti,ab,kw OR 'comoros':ti,ab,kw OR 'comoro islands':ti,ab,kw OR 'comores':ti,ab,kw OR 'mayotte':ti,ab,kw OR 'congo':ti,ab,kw OR 'zaire':ti,ab,kw OR 'costa rica':ti,ab,kw OR 'cote d ivoire':ti,ab,kw OR 'ivory coast':ti,ab,kw OR 'croatia':ti,ab,kw OR 'cuba':ti,ab,kw OR 'cyprus':ti,ab,kw OR 'czechoslovakia':ti,ab,kw OR 'czech republic':ti,ab,kw OR 'slovakia':ti,ab,kw OR 'slovak republic':ti,ab,kw OR 'djibouti':ti,ab,kw OR 'french somaliland':ti,ab,kw OR 'dominica':ti,ab,kw OR 'dominican republic':ti,ab,kw OR 'east timor':ti,ab,kw OR ('east' AND timur:ti,ab,kw) OR 'timor leste':ti,ab,kw OR 'ecuador':ti,ab,kw OR 'egypt':ti,ab,kw OR 'united arab republic':ti,ab,kw OR 'el salvador':ti,ab,kw OR 'eritrea':ti,ab,kw OR 'estonia':ti,ab,kw OR 'ethiopia':ti,ab,kw OR 'fiji':ti,ab,kw OR 'gabon':ti,ab,kw OR 'gabonese republic':ti,ab,kw OR 'gambia':ti,ab,kw OR 'gaza':ti,ab,kw OR 'georgia republic':ti,ab,kw OR 'georgian republic':ti,ab,kw OR

ghana:ti,ab,kw OR 'gold coast':ti,ab,kw OR greece:ti,ab,kw OR grenada:ti,ab,kw OR guatemala:ti,ab,kw OR guinea:ti,ab,kw OR guam:ti,ab,kw OR guiana:ti,ab,kw OR guyana:ti,ab,kw OR haiti:ti,ab,kw OR honduras:ti,ab,kw OR hungary:ti,ab,kw OR india:ti,ab,kw OR maldives:ti,ab,kw OR indonesia:ti,ab,kw OR iran:ti,ab,kw OR iraq:ti,ab,kw OR 'isle of man':ti,ab,kw OR jamaica:ti,ab,kw OR jordan:ti,ab,kw OR kazakhstan:ti,ab,kw OR kazakh:ti,ab,kw OR kenya:ti,ab,kw OR kiribati:ti,ab,kw OR korea:ti,ab,kw OR kosovo:ti,ab,kw OR kyrgyzstan:ti,ab,kw OR kirghizia:ti,ab,kw OR 'kyrgyz republic':ti,ab,kw OR kirghiz:ti,ab,kw OR kirgizstan:ti,ab,kw OR 'lao pdr':ti,ab,kw OR laos:ti,ab,kw OR latvia:ti,ab,kw OR lebanon:ti,ab,kw OR lesotho:ti,ab,kw OR basutoland:ti,ab,kw OR liberia:ti,ab,kw OR libya:ti,ab,kw OR lithuania:ti,ab,kw) OR (macedonia:ti,ab,kw OR madagascar:ti,ab,kw OR 'malagasy republic':ti,ab,kw OR malaysia:ti,ab,kw OR malaya:ti,ab,kw OR malay:ti,ab,kw OR sabah:ti,ab,kw OR sarawak:ti,ab,kw OR malawi:ti,ab,kw OR nyasaland:ti,ab,kw OR mali:ti,ab,kw OR malta:ti,ab,kw OR 'marshall islands':ti,ab,kw OR mauritania:ti,ab,kw OR mauritius:ti,ab,kw OR 'agalega islands':ti,ab,kw OR mexico:ti,ab,kw OR micronesia:ti,ab,kw OR 'middle east':ti,ab,kw OR moldova:ti,ab,kw OR moldovia:ti,ab,kw OR moldovan:ti,ab,kw OR mongolia:ti,ab,kw OR morocco:ti,ab,kw OR ifni:ti,ab,kw OR mozambique:ti,ab,kw OR myanmar:ti,ab,kw OR myanma:ti,ab,kw OR burma:ti,ab,kw OR namibia:ti,ab,kw OR nepal:ti,ab,kw OR 'netherlands antilles':ti,ab,kw OR 'new caledonia':ti,ab,kw OR nicaragua:ti,ab,kw OR niger:ti,ab,kw OR nigeria:ti,ab,kw OR 'northern mariana islands':ti,ab,kw OR oman:ti,ab,kw OR muscat:ti,ab,kw OR pakistan:ti,ab,kw OR palau:ti,ab,kw OR palestine:ti,ab,kw OR panama:ti,ab,kw OR paraguay:ti,ab,kw OR peru:ti,ab,kw OR philippines:ti,ab,kw OR philipines:ti,ab,kw OR phillipines:ti,ab,kw OR philippines:ti,ab,kw OR poland:ti,ab,kw OR portugal:ti,ab,kw OR 'puerto rico':ti,ab,kw OR romania:ti,ab,kw OR rumania:ti,ab,kw OR roumania:ti,ab,kw OR russia:ti,ab,kw OR russian:ti,ab,kw OR rwanada:ti,ab,kw OR ruanda:ti,ab,kw OR 'saint kitts':ti,ab,kw OR 'st kitts':ti,ab,kw OR nevis:ti,ab,kw OR 'saint lucia':ti,ab,kw OR 'st lucia':ti,ab,kw OR 'saint vincent':ti,ab,kw OR 'st vincent':ti,ab,kw OR grenadines:ti,ab,kw OR samoa:ti,ab,kw OR 'samoan islands':ti,ab,kw OR ('navigator' AND 'island':ti,ab,kw) OR ('navigator' AND 'islands':ti,ab,kw) OR 'sao tome':ti,ab,kw OR 'saudi arabia':ti,ab,kw OR senegal:ti,ab,kw OR serbia:ti,ab,kw OR montenegro:ti,ab,kw OR seychelles:ti,ab,kw OR 'sierra leone':ti,ab,kw OR slovenia:ti,ab,kw OR 'sri lanka':ti,ab,kw OR ceylon:ti,ab,kw OR 'solomon islands':ti,ab,kw OR somalia:ti,ab,kw OR sudan:ti,ab,kw OR suriname:ti,ab,kw OR surinam:ti,ab,kw OR swaziland:ti,ab,kw OR syria:ti,ab,kw OR tajikistan:ti,ab,kw OR tadjikistan:ti,ab,kw OR tadjik:ti,ab,kw OR tanzania:ti,ab,kw OR thailand:ti,ab,kw OR togo:ti,ab,kw OR 'togolese republic':ti,ab,kw OR tonga:ti,ab,kw OR trinidad:ti,ab,kw OR tobago:ti,ab,kw OR tunisia:ti,ab,kw OR turkey:ti,ab,kw OR turkmenistan:ti,ab,kw OR turkmen:ti,ab,kw OR uganda:ti,ab,kw OR ukraine:ti,ab,kw OR uruguay:ti,ab,kw OR ussr:ti,ab,kw OR 'soviet union':ti,ab,kw OR 'union of soviet socialist republics':ti,ab,kw OR uzbekistan:ti,ab,kw OR uzbek:ti,ab,kw OR vanuatu:ti,ab,kw OR 'new hebrides':ti,ab,kw OR venezuela:ti,ab,kw OR vietnam:ti,ab,kw OR 'viet nam':ti,ab,kw OR 'west bank':ti,ab,kw OR yemen:ti,ab,kw OR yugoslavia:ti,ab,kw OR zambia:ti,ab,kw OR zimbabwe:ti,ab,kw OR rhodesia:ti,ab,kw) OR ('developing country'/exp OR 'africa'/de OR 'north africa'/de OR 'africa south of the sahara'/de OR 'central africa'/de OR 'eastern africa'/de OR 'southern africa'/de OR 'western africa'/de OR 'asia'/de OR 'central asia'/de OR 'southeast asia'/de OR 'western asia'/de OR 'caribbean'/de OR 'caribbean islands'/de OR 'south america'/de OR 'south and central america'/de OR 'central america'/de OR 'afghanistan'/de OR 'albania'/de OR 'algeria'/de OR 'american samoa'/de OR 'angola'/de OR 'antigua and barbuda'/de OR 'argentina'/de OR 'armenia'/de OR 'azerbaijan'/de OR 'bahrain'/de OR 'bangladesh'/de OR 'barbados'/de OR 'benin'/de OR 'republic of belarus'/de OR 'belize'/de OR 'bhutan'/de OR 'bolivia'/de OR 'bosnia and herzegovina'/de OR 'botswana'/de OR 'brazil'/de OR 'bulgaria'/de OR 'burkina faso'/de OR 'burundi'/de OR 'cambodia'/de OR 'cameroon'/de OR 'cabo verde'/de OR 'central african republic'/de OR 'chad'/de OR 'chile'/de OR 'china'/de OR 'colombia'/de OR 'comoros'/de OR 'congo'/de OR 'costa rica'/de OR 'cote d'ivoire'/de OR 'croatia'/de OR 'cuba'/de OR 'cyprus'/de OR 'czechoslovakia'/de OR 'czech republic'/de OR 'slovakia'/de OR 'djibouti'/de OR 'democratic republic of the congo'/de OR 'dominica'/de OR 'dominican republic'/de OR 'timor-leste'/de OR 'ecuador'/de OR 'egypt'/de OR 'el salvador'/de OR 'eritrea'/de OR 'estonia'/de OR 'ethiopia'/de OR 'fiji'/de OR 'gabon'/de OR 'gambia'/de OR 'georgia (republic)'/de OR 'ghana'/de OR 'greece'/de OR 'grenada'/de OR 'guatemala'/de OR 'guinea'/de OR 'guinea-bissau'/de OR 'guam'/de OR 'guyana'/de OR 'haiti'/de OR 'honduras'/de OR 'hungary'/de OR 'india'/de OR 'indonesia'/de OR 'iran'/de OR 'iraq'/de OR 'jamaica'/de OR 'jordan'/de OR 'kazakhstan'/de OR 'kenya'/de OR 'korea'/de OR 'kosovo'/de OR 'kyrgyzstan'/de OR 'laos'/de OR 'latvia'/de OR 'lebanon'/de OR 'lesotho'/de OR 'liberia'/de OR 'libya'/de OR 'lithuania'/de OR 'macedonia (republic)'/de OR 'madagascar'/de OR 'malaysia'/de OR 'malawi'/de OR 'mali'/de OR 'malta'/de OR 'mauritania'/de OR

'mauritius'/de OR 'mexico'/de OR 'micronesia'/de OR 'middle east'/de OR 'moldova'/de OR 'mongolia'/de OR 'morocco'/de OR 'mozambique'/de OR 'myanmar'/de OR 'namibia'/de OR 'nepal'/de OR 'netherlands antilles'/de OR 'new caledonia'/de OR 'nicaragua'/de OR 'niger'/de OR 'nigeria'/de OR 'oman'/de OR 'pakistan'/de OR 'palau'/de OR 'panama'/de OR 'papua new guinea'/de OR 'paraguay'/de OR 'peru'/de OR 'philippines'/de OR 'poland'/de OR 'portugal'/de OR 'puerto rico'/de OR 'romania'/de OR 'russia'/de OR 'rwanda'/de OR 'saint kitts and nevis'/de OR 'saint lucia'/de OR 'saint vincent and the grenadines'/de OR 'samoa'/de OR 'saudi arabia'/de OR 'senegal'/de OR 'serbia'/de OR 'montenegro'/de OR 'seychelles'/de OR 'sierra leone'/de OR 'slovenia'/de OR 'sri lanka'/de OR 'somalia'/de OR 'south africa'/de OR 'sudan'/de OR 'suriname'/de OR 'swaziland'/de OR 'syria'/de OR 'tajikistan'/de OR 'tanzania'/de OR 'thailand'/de OR 'togo'/de OR 'tonga'/de OR 'trinidad and tobago'/de OR 'tunisia'/de OR 'turkey'/de OR 'turkmenistan'/de OR 'uganda'/de OR 'ukraine'/de OR 'uruguay'/de OR 'ussr'/de OR 'uzbekistan'/de OR 'vanuatu'/de OR 'venezuela'/de OR 'vietnam'/de OR 'yemen'/de OR 'yugoslavia'/de OR 'zambia'/de OR 'zimbabwe'/de)) AND (2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py OR 2014:py OR 2015:py OR 2016:py OR 2017:py OR 2018:py)
Combined: 799 results limited to 2008-2018

Scopus 4/3/2018

Concept 1: mHealth 1,145,619 Results Limited to 2008-2018

((TITLE-ABS-KEY ("cellular" OR "mobile" OR "phone" OR "smart" OR "text" OR "digital" OR "electronic" OR "interactive" OR "translation" OR "software" OR "tablet")) AND (TITLE-ABS-KEY ("app" OR "apps" OR "application" OR "applications" OR "alert" OR "alerts" OR "reminder" OR "reminders"))) OR ((TITLE-ABS-KEY ("cellular" OR "wearable" OR "digital")) AND (TITLE-ABS-KEY ("technology" OR "technologies"))) OR (TITLE-ABS-KEY ("mobile application" OR "mobile device" OR "mobile devices" OR "SMS" OR "short message service" OR "text message" OR "text-message" OR "text messages" OR "text-messages" OR "text messaging" OR "text-messaging" OR "texting" OR "textings")) OR (TITLE-ABS-KEY ("text contact" OR "text contacts" OR "interactive voice response")) OR (TITLE-ABS-KEY ("smartphone" OR "smartphones" OR "iphone" OR "iphones" OR "android" OR "androids" OR "ipad" OR "mHealth" OR "eHealth" OR "information technology" OR "information technologies" OR "communication technology" OR "communication technologies")) OR (TITLE-ABS-KEY ("telemedicine" OR "telehealth" OR "mobile" OR "digital health" OR "telephone" OR "phone" OR "phones" OR "telephone" OR "telephones")) AND (LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR , 2008))

Concept 2: Community Health workers: 47,466 Limited to 2008-2018

(TITLE-ABS-KEY ("community health workers" OR "community health worker" OR "community health workers")) OR ((TITLE-ABS-KEY("community health" OR "village health")) AND (TITLE-ABS-KEY("worker" OR "workers" OR "staff" OR "staffing" OR "personnel" OR "agent" OR "agents" OR "volunteer" OR "volunteers" OR "aide" OR "aides" OR "auxiliary" OR "auxiliaries" OR "helper" OR "helpers")))) OR (TITLE-ABS-KEY("CHW" OR "CHWs" OR "community health aide" OR "community health aides" OR "family planning personnel" OR "midwifery" OR "traditional birth attendant" OR "traditional birth attendants" OR "skilled birth attendant" OR "skilled birth attendants" OR "frontline worker" OR "frontline workers" OR "health worker" OR "health workers" OR "lay worker" OR "lay workers" OR "village health worker" OR "village health workers" OR "VHW" OR "VHWs" OR "midwife" OR "midwives" OR "barefoot doctors" OR "barefoot doctor" OR "health auxiliary" OR "health auxiliaries" OR "peer health worker" OR "peer health workers" OR "medical auxiliary" OR "medical auxiliaries" OR "health provider" OR "health providers" OR "lay counselor" OR "lay counselors" OR "lady health worker" OR "lady health workers" OR "LHW" OR "LHWs" OR "lay educator" OR "lay educators" OR "Activista" OR "activistas" OR "Agente comunitario de salud" OR "agentes comunitarios de salud" OR "Anganwadi" OR "accredited social health activist" OR "accredited social

health activists" OR "ASHA" OR "ASHAs" OR "Animatrice" OR "animatrices" OR "Barangay health worker" OR "Barangay Health Workers" OR "Basic health worker" OR "basic health workers" OR "Brigadista" OR "brigadistas" OR "Colaborador voluntario" OR "Colaboradores voluntarios" OR "Community drug distributor" OR "community drug distributors" OR "Community health agent" OR "community health agents" OR "Community health promoter" OR "community health promoters" OR "Community health representative" OR "community health representatives" OR "Community health volunteer" OR "community health volunteers" OR "Community nutrition worker" OR "community nutrition workers" OR "community nutrition volunteer" OR "community nutrition volunteers" OR "Community resource person" OR "community resource persons" OR "Female community health volunteer" OR "female community health volunteers" OR "Female multipurpose health worker" OR "female multipurpose health workers" OR "Health promoter" OR "health promoters" OR "Kader" OR "kaders" OR "Maternal and child health worker" OR "maternal and child health workers" OR "Monitora" OR "monitoras" OR "Mother coordinator" OR "mother coordinators" OR "Outreach educator" OR "outreach educators" OR "Promotora" OR "Promotoras" OR "Rural health motivator" OR "rural health motivators" OR "Shastho shebika" OR "Shasthya Shebika" OR "Shasthya Shebikas" OR "Sevika" OR "sevikas" OR "Village health helper" OR "village health helpers" OR "Village drug-kit manager" OR "village drug-kit managers" OR "Saksham Sahaya" OR "Saksham Sahayaks" OR "Raedat" OR "Raedat Refiat" OR "Accompagnateurs" OR "Accompagnateur" OR "Behvarz" OR "behvarzan" OR "Dai" OR "Dais" OR "Bidan Kampong" OR "bidan kampungs" OR "bidan kampong" OR "agents de santé" OR "agent de santé")) AND (LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR , 2008))

Concept 3: LMIC: 140,252 Results

(TITLE-ABS-KEY ("developing country" OR "developing countries" OR "developing nation" OR "developing nations" OR "developing population" OR "developing populations" OR "developing world" OR "less developed country" OR "less developed countries" OR "less developed nation" OR "less developed nations" OR "less developed world" OR "lesser developed countries" OR "lesser developed nations" OR "under developed country" OR "under developed countries" OR "under developed nations" OR "under developed world" OR "underdeveloped country" OR "underdeveloped countries" OR "underdeveloped nations" OR "underdeveloped population" OR "underdeveloped world" OR "middle income country" OR "middle income countries" OR "middle income nation" OR "middle income nations" OR "middle income population" OR "middle income populations" OR "low income country" OR "low income countries" OR "low income nation" OR "low income nations" OR "low income population" OR "low income populations" OR "lower income country" OR "lower income countries" OR "lower income nations" OR "lower income population" OR "lower income populations" OR "underserved countries" OR "underserved nations" OR "underserved population" OR "underserved populations" OR "under served population" OR "under served populations" OR "deprived countries" OR "deprived population" OR "deprived populations" OR "poor country" OR "poor countries" OR "poor nation" OR "poor nations" OR "poor population" OR "poor populations" OR "poor world" OR "poorer countries" OR "poorer nations" OR "poorer population" OR "poorer populations" OR "developing economy" OR "developing economies" OR "less developed economy" OR "less developed economies" OR "underdeveloped economies" OR "middle income economies" OR "low income economy" OR "low income economies" OR "low gdp" OR "low gnp" OR "low gross domestic" OR "low gross national" OR "lower gdp" OR "lower gross domestic" OR lmic OR Imics OR "third world" OR "lami country" OR "lami countries" OR "transitional country" OR "transitional countries")) OR (TITLE-ABS-KEY ("Africa" OR "northern Africa" OR "Africa South of the Sahara" OR "central Africa" OR "eastern Africa" OR "western Africa" OR "southern Africa" OR "Asia" OR "central asia" OR "southeast Asia" OR "western Asia" OR "Caribbean" OR "Caribbean Region" OR "West Indies" OR "South America" OR "Latin America" OR "Central

America" OR "Afghanistan" OR "Albania" OR "Algeria" OR "Angola" OR "Antigua" OR "american
 samoa" OR "Barbuda" OR "Antigua and
 Barbuda" OR "Argentina" OR "Armenia" OR "Armenian" OR "Aruba" OR "Azerbaijan" OR "Bahrai
 n" OR "Bangladesh" OR "Barbados" OR "Benin" OR "Byelarus" OR "Byelorussian" OR "Belarus"
 OR "Belorussian" OR "republic of
 Belarus" OR "Belorussia" OR "Belize" OR "Bhutan" OR "Bolivia" OR "Bosnia" OR "Herzegovina"
 OR "bosnia and
 Herzegovina" OR "Hercegovina" OR "Botswana" OR "Brasil" OR "Brazil" OR "Bulgaria" OR "Burki
 na Faso" OR "Burkina Fasso" OR "Upper
 Volta" OR "Burundi" OR "Urundi" OR "Cambodia" OR "Khmer
 Republic" OR "Kampuchea" OR "Cameroon" OR "Cameroons" OR "Cameron" OR "Cape
 Verde" OR "cabo verde" OR "Central African
 Republic" OR "Chad" OR "Chile" OR "China" OR "Colombia" OR "Comoros" OR "Comoro
 Islands" OR "Comores" OR "Mayotte" OR "Congo" OR "Democratic Republic of the
 Congo" OR "Zaire" OR "Costa Rica" OR "Cote d'Ivoire" OR "Ivory
 Coast" OR "Croatia" OR "Cuba" OR "Cyprus" OR "Czechoslovakia" OR "Czech
 Republic" OR "Slovakia" OR "Slovak Republic" OR "Djibouti" OR "French
 Somaliland" OR "Dominica" OR "Dominican Republic" OR "East Timor" OR "(East AND
 Timur)" OR "Timor Leste" OR "Ecuador" OR "Egypt" OR "United Arab Republic" OR "El
 Salvador" OR "Eritrea" OR "Estonia" OR "Ethiopia" OR "Fiji" OR "Gabon" OR "Gabonese
 Republic" OR "Gambia" OR "Gaza" OR "Georgia Republic" OR "Georgia (republic)" OR "Georgian
 Republic" OR "Ghana" OR "Gold
 Coast" OR "Greece" OR "Grenada" OR "Guatemala" OR "Guinea" OR "guinea-
 bissau" OR "Guam" OR "Guiana" OR "Guyana" OR "Haiti" OR "Honduras" OR "Hungary" OR "In
 dia" OR "Maldives" OR "Indonesia" OR "Iran" OR "Iraq" OR "Isle of
 Man" OR "Jamaica" OR "Jordan" OR "Kazakhstan" OR "Kazakh" OR "Kenya" OR "Kiribati" OR "
 Korea" OR "Kosovo" OR "Kyrgyzstan" OR "Kirghizia" OR "Kyrgyz
 Republic" OR "Kirghiz" OR "Kirgizstan" OR "" lao AND pdr "" OR "Laos" OR "Latvia" OR "Leban
 on" OR "Lesotho" OR "Basutoland" OR "Liberia" OR "Libya" OR "Lithuania" OR "Macedonia" OR
 "Madagascar" OR "Malagasy
 Republic" OR "Malaysia" OR "Malaya" OR "Malay" OR "Sabah" OR "Sarawak" OR "Malawi" OR
 "Nyasaland" OR "Mali" OR "Malta" OR "Marshall
 Islands" OR "Mauritania" OR "Mauritius" OR "Agalega
 Islands" OR "Mexico" OR "Micronesia" OR "Middle
 East" OR "Moldova" OR "Moldovia" OR "Moldovian" OR "Mongolia" OR "Montenegro" OR "Moroc
 co" OR "Ifni" OR "Mozambique" OR "Myanmar" OR "Myanma" OR "Burma" OR "Namibia" OR "N
 epal" OR "Netherlands Antilles" OR "New
 Caledonia" OR "Nicaragua" OR "Niger" OR "Nigeria" OR "Northern Mariana
 Islands" OR "Oman" OR "Muscat" OR "Pakistan" OR "Palau" OR "Palestine" OR "Panama" OR "
 papua new
 guinea" OR "Paraguay" OR "Peru" OR "Philippines" OR "Philipines" OR "Phillipines" OR "Phillippi
 nes" OR "Poland" OR "Portugal" OR "Puerto
 Rico" OR "Romania" OR "Rumania" OR "Roumania" OR "Russia" OR "Russia (Pre-
 1917)" OR "Russian" OR "Rwanda" OR "Ruanda" OR "Saint Kitts" OR "St
 Kitts" OR "Nevis" OR "Saint Kitts and Nevis" OR "Saint Lucia" OR "St Lucia" OR "Saint
 Vincent" OR "St Vincent" OR "Grenadines" OR "Saint Vincent and the
 Grenadines" OR "Samoa" OR "Samoan Islands" OR "(Navigator AND Island)" OR "(Navigator AND
 Islands)" OR "Sao Tome" OR "Saudi
 Arabia" OR "Senegal" OR "Serbia" OR "Montenegro" OR "Seychelles" OR "south
 Africa" OR "Sierra Leone" OR "Slovenia" OR "Sri Lanka" OR "Ceylon" OR "Solomon
 Islands" OR "Somalia" OR "Sudan" OR "Suriname" OR "Surinam" OR "Swaziland" OR "Syria" O
 R "Tajikistan" OR "Tadzhikistan" OR "Tadjikistan" OR "Tadzhik" OR "Tanzania" OR "Thailand" OR
 "Togo" OR "Togolese Republic" OR "Tonga" OR "Trinidad" OR "Tobago" OR "Trinidad and
 Tobago" OR "Tunisia" OR "Turkey" OR "Turkmenistan" OR "Turkmen" OR "Uganda" OR "Ukraine
 " OR "Uruguay" OR "USSR" OR "Soviet Union" OR "Union of Soviet Socialist
 Republics" OR "Uzbekistan" OR "Uzbek" OR "Vanuatu" OR "New

Hebrides" OR "Venezuela" OR "Vietnam" OR "Viet Nam" OR "West Bank" OR "Yemen" OR "Yugoslavia" OR "Zambia" OR "Zimbabwe" OR "Rhodesia")) AND (LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR , 2008))

Combined: 325 Results

((TITLE-ABS-KEY ("developing country" OR "developing countries" OR "developing nation" OR "developing nations" OR "developing population" OR "developing populations" OR "developing world" OR "less developed country" OR "less developed countries" OR "less developed nation" OR "less developed nations" OR "less developed world" OR "lesser developed countries" OR "lesser developed nations" OR "under developed country" OR "under developed countries" OR "under developed nations" OR "under developed world" OR "underdeveloped country" OR "underdeveloped countries" OR "underdeveloped nations" OR "underdeveloped population" OR "underdeveloped world" OR "middle income country" OR "middle income countries" OR "middle income nation" OR "middle income nations" OR "middle income population" OR "middle income populations" OR "low income country" OR "low income countries" OR "low income nation" OR "low income nations" OR "low income population" OR "low income populations" OR "lower income country" OR "lower income countries" OR "lower income nations" OR "lower income population" OR "lower income populations" OR "underserved countries" OR "underserved nations" OR "underserved population" OR "underserved populations" OR "under served population" OR "under served populations" OR "deprived countries" OR "deprived population" OR "deprived populations" OR "poor country" OR "poor countries" OR "poor nation" OR "poor nations" OR "poor population" OR "poor populations" OR "poor world" OR "poorer countries" OR "poorer nations" OR "poorer population" OR "poorer populations" OR "developing economy" OR "developing economies" OR "less developed economy" OR "less developed economies" OR "underdeveloped economies" OR "middle income economies" OR "low income economy" OR "low income economies" OR "low gdp" OR "low gnp" OR "low gross domestic" OR "low gross national" OR "lower gdp" OR "lower gross domestic" OR Imic OR Imics OR "third world" OR "lami country" OR "lami countries" OR "transitional country" OR "transitional countries")) OR (TITLE-ABS-KEY ("Africa" OR "northern Africa" OR "Africa South of the Sahara" OR "central Africa" OR "eastern Africa" OR "western Africa" OR "southern Africa" OR "Asia" OR "central asia" OR "southeast Asia" OR "western Asia" OR "Caribbean" OR "Caribbean Region" OR "West Indies" OR "South America" OR "Latin America" OR "Central America" OR "Afghanistan" OR "Albania" OR "Algeria" OR "Angola" OR "Antigua" OR "american samoa" OR "Barbuda" OR "Antigua and Barbuda" OR "Argentina" OR "Armenia" OR "Armenian" OR "Aruba" OR "Azerbaijan" OR "Bahrain" OR "Bangladesh" OR "Barbados" OR "Benin" OR "Byelarus" OR "Byelorussian" OR "Belarus" OR "Belorussian" OR "republic of Belarus" OR "Belorussia" OR "Belize" OR "Bhutan" OR "Bolivia" OR "Bosnia" OR "Herzegovina" OR "bosnia and Herzegovina" OR "Hercegovina" OR "Botswana" OR "Brasil" OR "Brazil" OR "Bulgaria" OR "Burkina Faso" OR "Burkina Fasso" OR "Upper Volta" OR "Burundi" OR "Urundi" OR "Cambodia" OR "Khmer Republic" OR "Kampuchea" OR "Cameroon" OR "Cameroons" OR "Cameron" OR "Cape Verde" OR "cabo verde" OR "Central African Republic" OR "Chad" OR "Chile" OR "China" OR "Colombia" OR "Comoros" OR "Comoro Islands" OR "Comores" OR "Mayotte" OR "Congo" OR "Democratic Republic of the Congo" OR "Zaire" OR "Costa Rica" OR "Cote d'Ivoire" OR "Ivory Coast" OR "Croatia" OR "Cuba" OR "Cyprus" OR "Czechoslovakia" OR "Czech Republic" OR "Slovakia" OR "Slovak Republic" OR "Djibouti" OR "French Somaliland" OR "Dominica" OR "Dominican Republic" OR "East Timor" OR "(East AND Timur)" OR "Timor Leste" OR "Ecuador" OR "Egypt" OR "United Arab Republic" OR "El Salvador" OR "Eritrea" OR "Estonia" OR "Ethiopia" OR "Fiji" OR "Gabon" OR "Gabonese

Republic" OR "Gambia" OR "Gaza" OR "Georgia Republic" OR "Georgia (republic)" OR "Georgian Republic" OR "Ghana" OR "Gold Coast" OR "Greece" OR "Grenada" OR "Guatemala" OR "Guinea" OR "guinea-bissau" OR "Guam" OR "Guiana" OR "Guyana" OR "Haiti" OR "Honduras" OR "Hungary" OR "India" OR "Maldives" OR "Indonesia" OR "Iran" OR "Iraq" OR "Isle of Man" OR "Jamaica" OR "Jordan" OR "Kazakhstan" OR "Kazakh" OR "Kenya" OR "Kiribati" OR "Korea" OR "Kosovo" OR "Kyrgyzstan" OR "Kirghizia" OR "Kyrgyz Republic" OR "Kirghiz" OR "Kirgizstan" OR "" lao AND pdr "" OR "Laos" OR "Latvia" OR "Lebanon" OR "Lesotho" OR "Basutoland" OR "Liberia" OR "Libya" OR "Lithuania" OR "Macedonia" OR "Madagascar" OR "Malagasy Republic" OR "Malaysia" OR "Malaya" OR "Malay" OR "Sabah" OR "Sarawak" OR "Malawi" OR "Nyasaland" OR "Mali" OR "Malta" OR "Marshall Islands" OR "Mauritania" OR "Mauritius" OR "Agalega Islands" OR "Mexico" OR "Micronesia" OR "Middle East" OR "Moldova" OR "Moldovia" OR "Moldovian" OR "Mongolia" OR "Montenegro" OR "Morocco" OR "Ifni" OR "Mozambique" OR "Myanmar" OR "Myanma" OR "Burma" OR "Namibia" OR "Nepal" OR "Netherlands Antilles" OR "New Caledonia" OR "Nicaragua" OR "Niger" OR "Nigeria" OR "Northern Mariana Islands" OR "Oman" OR "Muscat" OR "Pakistan" OR "Palau" OR "Palestine" OR "Panama" OR "papua new guinea" OR "Paraguay" OR "Peru" OR "Philippines" OR "Philipines" OR "Phillipines" OR "Phillippines" OR "Poland" OR "Portugal" OR "Puerto Rico" OR "Romania" OR "Rumania" OR "Roumania" OR "Russia" OR "Russia (Pre-1917)" OR "Russian" OR "Rwanda" OR "Ruanda" OR "Saint Kitts" OR "St Kitts" OR "Nevis" OR "Saint Kitts and Nevis" OR "Saint Lucia" OR "St Lucia" OR "Saint Vincent" OR "St Vincent" OR "Grenadines" OR "Saint Vincent and the Grenadines" OR "Samoa" OR "Samoan Islands" OR "(Navigator AND Island)" OR "(Navigator AND Islands)" OR "Sao Tome" OR "Saudi Arabia" OR "Senegal" OR "Serbia" OR "Montenegro" OR "Seychelles" OR "south Africa" OR "Sierra Leone" OR "Slovenia" OR "Sri Lanka" OR "Ceylon" OR "Solomon Islands" OR "Somalia" OR "Sudan" OR "Suriname" OR "Surinam" OR "Swaziland" OR "Syria" OR "Tajikistan" OR "Tadzhikistan" OR "Tadjikistan" OR "Tadzhik" OR "Tanzania" OR "Thailand" OR "Togo" OR "Togolese Republic" OR "Tonga" OR "Trinidad" OR "Tobago" OR "Trinidad and Tobago" OR "Tunisia" OR "Turkey" OR "Turkmenistan" OR "Turkmen" OR "Uganda" OR "Ukraine" OR "Uruguay" OR "USSR" OR "Soviet Union" OR "Union of Soviet Socialist Republics" OR "Uzbekistan" OR "Uzbek" OR "Vanuatu" OR "New Hebrides" OR "Venezuela" OR "Vietnam" OR "Viet Nam" OR "West Bank" OR "Yemen" OR "Yugoslavia" OR "Zambia" OR "Zimbabwe" OR "Rhodesia"))) AND ((TITLE-ABS-KEY ("community health workers" OR "community health worker" OR "community health workers")) OR ((TITLE-ABS-KEY ("community health" OR "village health")) AND (TITLE-ABS-KEY ("worker" OR "workers" OR "staff" OR "staffing" OR "personnel" OR "agent" OR "agents" OR "volunteer" OR "volunteers" OR "aide" OR "aides" OR "auxiliary" OR "auxiliaries" OR "helper" OR "helpers"))) OR (TITLE-ABS-KEY ("CHW" OR "CHWs" OR "community health aide" OR "community health aides" OR "family planning personnel" OR "midwifery" OR "traditional birth attendant" OR "traditional birth attendants" OR "skilled birth attendant" OR "skilled birth attendants" OR "frontline worker" OR "frontline workers" OR "health worker" OR "health workers" OR "lay worker" OR "lay workers" OR "village health worker" OR "village health workers" OR "VHW" OR "VHWs" OR "midwife" OR "midwives" OR "barefoot doctors" OR "barefoot doctor" OR "health auxiliary" OR "health auxiliaries" OR "peer health worker" OR "peer health workers" OR "medical auxiliary" OR "medical auxiliaries" OR "health provider" OR "health providers" OR "lay counselor" OR "lay counselors" OR "lady health worker" OR "lady health workers" OR "LHW" OR "LHWs" OR "lay educator" OR "lay educators" OR "Activista" OR "activistas" OR "Agente comunitario de salud" OR "agentes comunitarios de salud" OR "Anganwadi" OR "accredited social health activist" OR "accredited social health activists" OR "ASHA" OR "ASHAs" OR "Animatrice" OR "animatrices" OR "Barangay health worker" OR "Barangay Health Workers" OR "Basic health worker" OR "basic health

workers" OR "Brigadista" OR "brigadistas" OR "Colaborador voluntario" OR "Colaboradores voluntarios" OR "Community drug distributor" OR "community drug distributors" OR "Community health agent" OR "community health agents" OR "Community health promoter" OR "community health promoters" OR "Community health representative" OR "community health representatives" OR "Community health volunteer" OR "community health volunteers" OR "Community nutrition worker" OR "community nutrition workers" OR "community nutrition volunteer" OR "community nutrition volunteers" OR "Community resource person" OR "community resource persons" OR "Female community health volunteer" OR "female community health volunteers" OR "Female multipurpose health worker" OR "female multipurpose health workers" OR "Health promoter" OR "health promoters" OR "Kader" OR "kaders" OR "Maternal and child health worker" OR "maternal and child health workers" OR "Monitora" OR "monitoras" OR "Mother coordinator" OR "mother coordinators" OR "Outreach educator" OR "outreach educators" OR "Promotora" OR "Promotoras" OR "Rural health motivator" OR "rural health motivators" OR "Shastho shebika" OR "Shasthya Shebika" OR "Shasthya Shebikas" OR "Sevika" OR "sevikas" OR "Village health helper" OR "village health helpers" OR "Village drug-kit manager" OR "village drug-kit managers" OR "Saksham Sahaya" OR "Saksham Sahayaks" OR "Raedat" OR "Raedat Refiat" OR "Accompagnateurs" OR "Accompagnateur" OR "Behvarz" OR "behvarzan" OR "Dai" OR "Dais" OR "Bidan Kampong" OR "bidan kampungs" OR "bidan kampong" OR "agents de santé" OR "agent de santé")) AND (((TITLE-ABS-KEY ("cellular" OR "mobile" OR "phone" OR "smart" OR "text" OR "digital" OR "electronic" OR "interactive" OR "translation" OR "software" OR "tablet")) AND (TITLE-ABS-KEY ("app" OR "apps" OR "application" OR "applications" OR "alert" OR "alerts" OR "reminder" OR "reminders"))) OR ((TITLE-ABS-KEY ("cellular" OR "wearable" OR "digital")) AND (TITLE-ABS-KEY ("technology" OR "technologies"))) OR (TITLE-ABS-KEY ("mobile application" OR "mobile device" OR "mobile devices" OR "SMS" OR "short message service" OR "text message" OR "text-message" OR "text messages" OR "text-messages" OR "text messaging" OR "text-messaging" OR "texting" OR "textings")) OR (TITLE-ABS-KEY ("text contact" OR "text contacts" OR "interactive voice response")) OR (TITLE-ABS-KEY ("smartphone" OR "smartphones" OR "iphone" OR "iphones" OR "android" OR "androids" OR "ipad" OR "mHealth" OR "eHealth" OR "information technology" OR "information technologies" OR "communication technology" OR "communication technologies")) OR (TITLE-ABS-KEY ("telemedicine" OR "telehealth" OR "mobile" OR "digital health" OR "telephone" OR "phone" OR "phones" OR "telephone" OR "telephones"))) AND (LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013) OR LIMIT-TO (PUBYEAR , 2012) OR LIMIT-TO (PUBYEAR , 2011) OR LIMIT-TO (PUBYEAR , 2010) OR LIMIT-TO (PUBYEAR , 2009) OR LIMIT-TO (PUBYEAR , 2008))

CINAHL 4/3/2018

Concept 1 mHealth 60,692 Results Limited from 2008-2018

1. (MH "Telehealth") OR (MH "Telephone") OR (MH "Information Technology") (MH "Telephone") OR (MH "Cellular Phone") OR (MH "Telemedicine") OR (MH "Mobile Applications")
2. AB("ipad" OR "mobile device" OR "mobile devices" OR "SMS" OR "short message service" OR "text message" OR "text-message" OR "text messages" OR "text-messages" OR "text messaging" OR "text-messaging" OR "texting" OR "textings" OR "text contact" OR "text contacts" OR "interactive voice response" OR "smartphone" OR "smartphones" OR "iphone" OR "iphones" OR "android" OR "androids" OR "mHealth" OR "eHealth" OR "information technology" OR "information technologies" OR "communication technology" OR "communication technologies" OR "telemedicine" OR "telehealth" OR "mobile" OR "digital health" OR "telephone" OR "phone" OR "phones" OR "telephone" OR "telephones")
3. AB("cellular " OR "wearable" OR "digital") AND AB("technology" OR "technologies")

4. AB("cellular" OR "mobile" OR "phone" OR "smart" OR "text" OR "digital" OR "electronic" OR "interactive" OR "translation" OR "software" OR "tablet") AND AB("app" OR "apps" OR "application" OR "applications" OR "alert" OR "alerts" OR "reminder" OR "reminders")
5. TI("ipad" OR "mobile device" OR "mobile devices" OR "SMS" OR "short message service" OR "text message" OR "text-message" OR "text messages" OR "text-messages" OR "text messaging" OR "text-messaging" OR "texting" OR "textings" OR "text contact" OR "text contacts" OR "interactive voice response" OR "smartphone" OR "smartphones" OR "iphone" OR "iphones" OR "android" OR "androids" OR "mHealth" OR "eHealth" OR "information technology" OR "information technologies" OR "communication technology" OR "communication technologies" OR "telemedicine" OR "telehealth" OR "mobile" OR "digital health" OR "telephone" OR "phone" OR "phones" OR "telephone" OR "telephones")
6. TI("cellular " OR "wearable" OR "digital") AND TI("technology" OR "technologies")
7. TI("cellular" OR "mobile" OR "phone" OR "smart" OR "text" OR "digital" OR "electronic" OR "interactive" OR "translation" OR "software" OR "tablet") AND TI("app" OR "apps" OR "application" OR "applications" OR "alert" OR "alerts" OR "reminder" OR "reminders")

Concept 2: Community Health workers 25,528 Results

1. (MH "Community Health Worker") OR (MH "Midwives")
2. AB("community health" OR "village health") AND AB("worker" OR "workers" OR "staff" OR "staffing" OR "personnel" OR "agent" OR "agents" OR "volunteer" OR "volunteers" OR "aide" OR "aides" OR "auxiliary" OR "auxiliaries" OR "helper" OR "helpers")
3. TI("community health" OR "village health") AND TI("worker" OR "workers" OR "staff" OR "staffing" OR "personnel" OR "agent" OR "agents" OR "volunteer" OR "volunteers" OR "aide" OR "aides" OR "auxiliary" OR "auxiliaries" OR "helper" OR "helpers")
4. AB("community health workers" OR "community health worker" OR "community health workers" OR "CHW" OR "CHWs" OR "community health aide" OR "community health aides" OR "family planning personnel" OR "midwifery" OR "traditional birth attendant" OR "traditional birth attendants" OR "skilled birth attendant" OR "skilled birth attendants" OR "frontline worker" OR "frontline workers" OR "health worker" OR "health workers" OR "lay worker" OR "lay workers" OR "village health worker" OR "village health workers" OR "VHW" OR "VHWs" OR "midwife" OR "midwives" OR "barefoot doctors" OR "barefoot doctor" OR "health auxiliary" OR "health auxiliaries" OR "peer health worker" OR "peer health workers" OR "medical auxiliary" OR "medical auxiliaries" OR "health provider" OR "health providers" OR "lay counselor" OR "lay counselors" OR "lady health worker" OR "lady health workers" OR "LHW" OR "LHWs" OR "lay educator" OR "lay educators" OR "Activista" OR "activistas" OR "Agente comunitario de salud" OR "agentes comunitarios de salud" OR "Anganwadi" OR "accredited social health activist" OR "accredited social health activists" OR "ASHA" OR "ASHAs" OR "Animatrice" OR "animatrices" OR "Barangay health worker" OR "Barangay Health Workers" OR "Basic health worker" OR "basic health workers" OR "Brigadista" OR "brigadistas" OR "Colaborador voluntario" OR "Colaboradores voluntarios" OR "Community drug distributor" OR "community drug distributors" OR "Community health agent" OR "community health agents" OR "Community health promoter" OR "community health promoters" OR "Community health representative" OR "community health representatives" OR "Community health volunteer" OR "community health volunteers" OR "Community nutrition worker" OR "community nutrition workers" OR "community nutrition volunteer" OR "community nutrition volunteers" OR "Community resource person" OR "community resource persons" OR "Female community health volunteer" OR "female community health volunteers" OR "Female multipurpose health worker" OR "female multipurpose health workers" OR "Health promoter" OR "health promoters" OR "Kader" OR "kaders" OR "Maternal and child health worker" OR "maternal and child health workers" OR "Monitora" OR "monitoras" OR "Mother coordinator" OR "mother

coordinators" OR "Outreach educator" OR "outreach educators" OR "Promotora" OR "Promotoras" OR "Rural health motivator" OR "rural health motivators" OR "Shastho shebika" OR "Shasthya Shebika" OR "Shasthya Shebikas" OR "Sevika" OR "sevikas" OR "Village health helper" OR "village health helpers" OR "Village drug-kit manager" OR "village drug-kit managers" OR "Saksham Sahaya" OR "Saksham Sahayaks" OR "Raedat" OR "Raedat Refiat" OR "Accompagnateurs" OR "Accompagnateur" OR "Behvarz" OR "behvarzan" OR "Dai" OR "Dais" OR "Bidan Kampong" OR "bidan kampungs" OR "bidan kampong" OR "agents de santé" OR "agent de santé")

5. TI("community health workers" OR "community health worker" OR "community health workers" OR "CHW" OR "CHWs" OR "community health aide" OR "community health aides" OR "family planning personnel" OR "midwifery" OR "traditional birth attendant" OR "traditional birth attendants" OR "skilled birth attendant" OR "skilled birth attendants" OR "frontline worker" OR "frontline workers" OR "health worker" OR "health workers" OR "lay worker" OR "lay workers" OR "village health worker" OR "village health workers" OR "VHW" OR "VHWs" OR "midwife" OR "midwives" OR "barefoot doctors" OR "barefoot doctor" OR "health auxiliary" OR "health auxiliaries" OR "peer health worker" OR "peer health workers" OR "medical auxiliary" OR "medical auxiliaries" OR "health provider" OR "health providers" OR "lay counselor" OR "lay counselors" OR "lady health worker" OR "lady health workers" OR "LHW" OR "LHWs" OR "lay educator" OR "lay educators" OR "Activista" OR "activistas" OR "Agente comunitario de salud" OR "agentes comunitarios de salud" OR "Anganwadi" OR "accredited social health activist" OR "accredited social health activists" OR "ASHA" OR "ASHAs" OR "Animatrice" OR "animatrices" OR "Barangay health worker" OR "Barangay Health Workers" OR "Basic health worker" OR "basic health workers" OR "Brigadista" OR "brigadistas" OR "Colaborador voluntario" OR "Colaboradores voluntarios" OR "Community drug distributor" OR "community drug distributors" OR "Community health agent" OR "community health agents" OR "Community health promoter" OR "community health promoters" OR "Community health representative" OR "community health representatives" OR "Community health volunteer" OR "community health volunteers" OR "Community nutrition worker" OR "community nutrition workers" OR "community nutrition volunteer" OR "community nutrition volunteers" OR "Community resource person" OR "community resource persons" OR "Female community health volunteer" OR "female community health volunteers" OR "Female multipurpose health worker" OR "female multipurpose health workers" OR "Health promoter" OR "health promoters" OR "Kader" OR "kaders" OR "Maternal and child health worker" OR "maternal and child health workers" OR "Monitora" OR "monitoras" OR "Mother coordinator" OR "mother coordinators" OR "Outreach educator" OR "outreach educators" OR "Promotora" OR "Promotoras" OR "Rural health motivator" OR "rural health motivators" OR "Shastho shebika" OR "Shasthya Shebika" OR "Shasthya Shebikas" OR "Sevika" OR "sevikas" OR "Village health helper" OR "village health helpers" OR "Village drug-kit manager" OR "village drug-kit managers" OR "Saksham Sahaya" OR "Saksham Sahayaks" OR "Raedat" OR "Raedat Refiat" OR "Accompagnateurs" OR "Accompagnateur" OR "Behvarz" OR "behvarzan" OR "Dai" OR "Dais" OR "Bidan Kampong" OR "bidan kampungs" OR "bidan kampong" OR "agents de santé" OR "agent de santé")

Concept 3: LMIC filter 281804

1. (MH "Developing Countries") OR (MH "Africa") OR (MH "Africa, Northern") OR (MH "Africa South of the Sahara") OR (MH "Africa, Central") OR (MH "Africa, Eastern") OR (MH "Africa, Southern") OR (MH "Africa, Western") OR (MH "Asia") OR (MH "Asia, Central") OR (MH "Asia, Southeastern") OR (MH "Asia, Western") OR (MH "Caribbean Region") OR (MH "West Indies") OR (MH "South America") OR (MH "Latin America") OR (MH "Central America") OR (MH "Afghanistan") OR (MH "Albania") OR (MH "Algeria") OR (MH "American Samoa") OR (MH "Angola") OR (MH "Antigua and Barbuda") OR (MH "Argentina") OR (MH "Armenia") OR (MH

"Azerbaijan") OR (MH "Bahrain") OR (MH "Bangladesh") OR (MH "Barbados") OR (MH "Benin")
 OR (MH "Byelarus") OR (MH "Belize") OR (MH "Bhutan") OR (MH "Bolivia") OR (MH "Bosnia-
 Herzegovina") OR (MH "Botswana") OR (MH "Brazil") OR (MH "Bulgaria") OR (MH "Burkina
 Faso") OR (MH "Burundi") OR (MH "Cambodia") OR (MH "Cameroon") OR (MH "Cape Verde")
 OR (MH "Central African Republic") OR (MH "Chad") OR (MH "Chile") OR (MH "China") OR (MH
 "Colombia") OR (MH "Comoros") OR (MH "Congo") OR (MH "Costa Rica") OR (MH "Cote
 d'Ivoire") OR (MH "Croatia") OR (MH "Cuba") OR (MH "Cyprus") OR (MH "Czechoslovakia") OR
 (MH "Czech Republic") OR (MH "Slovakia") OR (MH "Djibouti") OR (MH ""Democratic Republic of
 the Congo""") OR (MH "Dominica") OR (MH "Dominican Republic") OR (MH "East Timor") OR (MH
 "Ecuador") OR (MH "Egypt") OR (MH "El Salvador") OR (MH "Eritrea") OR (MH "Estonia") OR
 (MH "Ethiopia") OR (MH "Fiji") OR (MH "Gabon") OR (MH "Gambia") OR (MH ""Georgia
 (Republic)""") OR (MH "Ghana") OR (MH "Greece") OR (MH "Grenada") OR (MH "Guatemala")
 OR (MH "Guinea") OR (MH "Guinea-Bissau") OR (MH "Guam") OR (MH "Guyana") OR (MH
 "Haiti") OR (MH "Honduras") OR (MH "Hungary") OR (MH "India") OR (MH "Indonesia") OR (MH
 "Iran") OR (MH "Iraq") OR (MH "Jamaica") OR (MH "Jordan") OR (MH "Kazakhstan") OR (MH
 "Kenya") OR (MH "Korea") OR (MH "Kosovo") OR (MH "Kyrgyzstan") OR (MH "Laos") OR (MH
 "Latvia") OR (MH "Lebanon") OR (MH "Lesotho") OR (MH "Liberia") OR (MH "Libya") OR (MH
 "Lithuania") OR (MH "Macedonia") OR (MH "Madagascar") OR (MH "Malaysia") OR (MH
 "Malawi") OR (MH "Mali") OR (MH "Malta") OR (MH "Mauritania") OR (MH "Mauritius") OR (MH
 "Mexico") OR (MH "Micronesia") OR (MH "Middle East") OR (MH "Moldova") OR (MH "Mongolia")
 OR (MH "Montenegro") OR (MH "Morocco") OR (MH "Mozambique") OR (MH "Myanmar") OR
 (MH "Namibia") OR (MH "Nepal") OR (MH "Netherlands Antilles") OR (MH "New Caledonia") OR
 (MH "Nicaragua") OR (MH "Niger") OR (MH "Nigeria") OR (MH "Oman") OR (MH "Pakistan") OR
 (MH "Palau") OR (MH "Panama") OR (MH "Papua New Guinea") OR (MH "Paraguay") OR (MH
 "Peru") OR (MH "Philippines") OR (MH "Poland") OR (MH "Portugal") OR (MH "Puerto Rico") OR
 (MH "Romania") OR (MH "Russia") OR (MH "Rwanda") OR (MH ""Saint Kitts and Nevis""") OR
 (MH "Saint Lucia") OR (MH ""Saint Vincent and the Grenadines""") OR (MH "Samoa") OR (MH
 "Saudi Arabia") OR (MH "Senegal") OR (MH "Serbia") OR (MH "Montenegro") OR (MH
 "Seychelles") OR (MH "Sierra Leone") OR (MH "Slovenia") OR (MH "Sri Lanka") OR (MH
 "Somalia") OR (MH "South Africa") OR (MH "Sudan") OR (MH "Suriname") OR (MH "Swaziland")
 OR (MH "Syria") OR (MH "Tajikistan") OR (MH "Tanzania") OR (MH "Thailand") OR (MH "Togo")
 OR (MH "Tonga") OR (MH ""Trinidad and Tobago""") OR (MH "Tunisia") OR (MH "Turkey") OR
 (MH "Turkmenistan") OR (MH "Uganda") OR (MH "Ukraine") OR (MH "Uruguay") OR (MH
 "USSR") OR (MH "Uzbekistan") OR (MH "Vanuatu") OR (MH "Venezuela") OR (MH "Vietnam")
 OR (MH "Yemen") OR (MH "Yugoslavia") OR (MH "Zambia") OR (MH "Zimbabwe")

2. AB("Macedonia" OR "Madagascar" OR "Malagasy Republic" OR "Malaysia" OR "Malaya" OR
 "Malay" OR "Sabah" OR "Sarawak" OR "Malawi" OR "Nyasaland" OR "Mali" OR "Malta" OR
 "Marshall Islands" OR "Mauritania" OR "Mauritius" OR "Agalega Islands" OR "Mexico" OR
 "Micronesia" OR "Middle East" OR "Moldova" OR "Moldovia" OR "Moldovian" OR "Mongolia" OR
 "Montenegro" OR "Morocco" OR "Ifni" OR "Mozambique" OR "Myanmar" OR "Myanma" OR
 "Burma" OR "Namibia" OR "Nepal" OR "Netherlands Antilles" OR "New Caledonia" OR
 "Nicaragua" OR "Niger" OR "Nigeria" OR "Northern Mariana Islands" OR "Oman" OR "Muscat"
 OR "Pakistan" OR "Palau" OR "Palestine" OR "Panama" OR "Paraguay" OR "Peru" OR
 "Philippines" OR "Phillipines" OR "Phillipines" OR "Phillippines" OR "Poland" OR "Portugal" OR
 "Puerto Rico" OR "Romania" OR "Rumania" OR "Roumania" OR "Russia" OR "Russian" OR
 "Rwanda" OR "Ruanda" OR "Saint Kitts" OR "St Kitts" OR "Nevis" OR "Saint Lucia" OR "St Lucia"
 OR "Saint Vincent" OR "St Vincent" OR "Grenadines" OR "Samoa" OR "Samoan Islands" OR
 "Navigator Island" OR "Navigator Islands" OR "Sao Tome" OR "Saudi Arabia" OR "Senegal" OR
 "Serbia" OR "Montenegro" OR "Seychelles" OR "Sierra Leone" OR "Slovenia" OR "Sri Lanka" OR
 "Ceylon" OR "Solomon Islands" OR "Somalia" OR "Sudan" OR "Suriname" OR "Surinam" OR
 "Swaziland" OR "Syria" OR "Tajikistan" OR "Tadzhikistan" OR "Tadjikistan" OR "Tadzhik" OR
 "Tanzania" OR "Thailand" OR "Togo" OR "Togolese Republic" OR "Tonga" OR "Trinidad" OR
 "Tobago" OR "Tunisia" OR "Turkey" OR "Turkmenistan" OR "Turkmen" OR "Uganda" OR
 "Ukraine" OR "Uruguay" OR "USSR" OR "Soviet Union" OR "Union of Soviet Socialist Republics"
 OR "Uzbekistan" OR "Uzbek" OR "Vanuatu" OR "New Hebrides" OR "Venezuela" OR "Vietnam")

OR "Viet Nam" OR "West Bank" OR "Yemen" OR "Yugoslavia" OR "Zambia" OR "Zimbabwe" OR "Rhodesia")

3. TI("Macedonia" OR "Madagascar" OR "Malagasy Republic" OR "Malaysia" OR "Malaya" OR "Malay" OR "Sabah" OR "Sarawak" OR "Malawi" OR "Nyasaland" OR "Mali" OR "Malta" OR "Marshall Islands" OR "Mauritania" OR "Mauritius" OR "Agalega Islands" OR "Mexico" OR "Micronesia" OR "Middle East" OR "Moldova" OR "Moldovia" OR "Moldovian" OR "Mongolia" OR "Montenegro" OR "Morocco" OR "Ifni" OR "Mozambique" OR "Myanmar" OR "Myanma" OR "Burma" OR "Namibia" OR "Nepal" OR "Netherlands Antilles" OR "New Caledonia" OR "Nicaragua" OR "Niger" OR "Nigeria" OR "Northern Mariana Islands" OR "Oman" OR "Muscat" OR "Pakistan" OR "Palau" OR "Palestine" OR "Panama" OR "Paraguay" OR "Peru" OR "Philippines" OR "Phillipines" OR "Phillippines" OR "Phillippines" OR "Poland" OR "Portugal" OR "Puerto Rico" OR "Romania" OR "Rumania" OR "Roumania" OR "Russia" OR "Russian" OR "Rwanda" OR "Ruanda" OR "Saint Kitts" OR "St Kitts" OR "Nevis" OR "Saint Lucia" OR "St Lucia" OR "Saint Vincent" OR "St Vincent" OR "Grenadines" OR "Samoa" OR "Samoa Islands" OR "Navigator Island" OR "Navigator Islands" OR "Sao Tome" OR "Saudi Arabia" OR "Senegal" OR "Serbia" OR "Montenegro" OR "Seychelles" OR "Sierra Leone" OR "Slovenia" OR "Sri Lanka" OR "Ceylon" OR "Solomon Islands" OR "Somalia" OR "Sudan" OR "Suriname" OR "Surinam" OR "Swaziland" OR "Syria" OR "Tajikistan" OR "Tadzhikistan" OR "Tadjikistan" OR "Tadzhik" OR "Tanzania" OR "Thailand" OR "Togo" OR "Togolese Republic" OR "Tonga" OR "Trinidad" OR "Tobago" OR "Tunisia" OR "Turkey" OR "Turkmenistan" OR "Turkmen" OR "Uganda" OR "Ukraine" OR "Uruguay" OR "USSR" OR "Soviet Union" OR "Union of Soviet Socialist Republics" OR "Uzbekistan" OR "Uzbek" OR "Vanuatu" OR "New Hebrides" OR "Venezuela" OR "Vietnam" OR "Viet Nam" OR "West Bank" OR "Yemen" OR "Yugoslavia" OR "Zambia" OR "Zimbabwe" OR "Rhodesia")
4. AB("Africa" OR "Asia" OR "Caribbean" OR "West Indies" OR "South America" OR "Latin America" OR "Central America" OR "Afghanistan" OR "Albania" OR "Algeria" OR "Angola" OR "Antigua" OR "Barbuda" OR "Argentina" OR "Armenia" OR "Armenian" OR "Aruba" OR "Azerbaijan" OR "Bahrain" OR "Bangladesh" OR "Barbados" OR "Benin" OR "Byelarus" OR "Byelorussian" OR "Belarus" OR "Belorussian" OR "Belorussia" OR "Belize" OR "Bhutan" OR "Bolivia" OR "Bosnia" OR "Herzegovina" OR "Hercegovina" OR "Botswana" OR "Brasil" OR "Brazil" OR "Bulgaria" OR "Burkina Faso" OR "Burkina Fasso" OR "Upper Volta" OR "Burundi" OR "Urundi" OR "Cambodia" OR "Khmer Republic" OR "Kampuchea" OR "Cameroon" OR "Cameroons" OR "Cameron" OR "Camerons" OR "Cape Verde" OR "Central African Republic" OR "Chad" OR "Chile" OR "China" OR "Colombia" OR "Comoros" OR "Comoro Islands" OR "Comores" OR "Mayotte" OR "Congo" OR "Zaire" OR "Costa Rica" OR "Cote d'Ivoire" OR "Ivory Coast" OR "Croatia" OR "Cuba" OR "Cyprus" OR "Czechoslovakia" OR "Czech Republic" OR "Slovakia" OR "Slovak Republic" OR "Djibouti" OR "French Somaliland" OR "Dominica" OR "Dominican Republic" OR "East Timor" OR "East Timur" OR "Timor Leste" OR "Ecuador" OR "Egypt" OR "United Arab Republic" OR "El Salvador" OR "Eritrea" OR "Estonia" OR "Ethiopia" OR "Fiji" OR "Gabon" OR "Gabonese Republic" OR "Gambia" OR "Gaza" OR "Georgia Republic" OR "Georgian Republic" OR "Ghana" OR "Gold Coast" OR "Greece" OR "Grenada" OR "Guatemala" OR "Guinea" OR "Guam" OR "Guiana" OR "Guyana" OR "Haiti" OR "Honduras" OR "Hungary" OR "India" OR "Maldives" OR "Indonesia" OR "Iran" OR "Iraq" OR "Isle of Man" OR "Jamaica" OR "Jordan" OR "Kazakhstan" OR "Kazakh" OR "Kenya" OR "Kiribati" OR "Korea" OR "Kosovo" OR "Kyrgyzstan" OR "Kirghizia" OR "Kyrgyz Republic" OR "Kirghiz" OR "Kirgizstan" OR "Lao PDR" OR "Laos" OR "Latvia" OR "Lebanon" OR "Lesotho" OR "Basutoland" OR "Liberia" OR "Libya" OR "Lithuania")
5. TI("Africa" OR "Asia" OR "Caribbean" OR "West Indies" OR "South America" OR "Latin America" OR "Central America" OR "Afghanistan" OR "Albania" OR "Algeria" OR "Angola" OR "Antigua" OR "Barbuda" OR "Argentina" OR "Armenia" OR "Armenian" OR "Aruba" OR "Azerbaijan" OR "Bahrain" OR "Bangladesh" OR "Barbados" OR "Benin" OR "Byelarus" OR "Byelorussian" OR "Belarus" OR "Belorussian" OR "Belorussia" OR "Belize" OR "Bhutan" OR "Bolivia" OR "Bosnia" OR "Herzegovina" OR "Hercegovina" OR "Botswana" OR "Brasil" OR "Brazil" OR "Bulgaria" OR "Burkina Faso" OR "Burkina Fasso" OR "Upper Volta" OR "Burundi" OR "Urundi" OR "Cambodia" OR "Khmer Republic" OR "Kampuchea" OR "Cameroon" OR "Cameroons" OR "Cameron" OR "Camerons" OR "Cape Verde" OR "Central African Republic" OR "Chad" OR "Chile" OR "China"

OR "Colombia" OR "Comoros" OR "Comoro Islands" OR "Comores" OR "Mayotte" OR "Congo" OR "Zaire" OR "Costa Rica" OR "Cote d'Ivoire" OR "Ivory Coast" OR "Croatia" OR "Cuba" OR "Cyprus" OR "Czechoslovakia" OR "Czech Republic" OR "Slovakia" OR "Slovak Republic" OR "Djibouti" OR "French Somaliland" OR "Dominica" OR "Dominican Republic" OR "East Timor" OR "East Timur" OR "Timor Leste" OR "Ecuador" OR "Egypt" OR "United Arab Republic" OR "El Salvador" OR "Eritrea" OR "Estonia" OR "Ethiopia" OR "Fiji" OR "Gabon" OR "Gabonese Republic" OR "Gambia" OR "Gaza" OR "Georgia Republic" OR "Georgian Republic" OR "Ghana" OR "Gold Coast" OR "Greece" OR "Grenada" OR "Guatemala" OR "Guinea" OR "Guam" OR "Guiana" OR "Guyana" OR "Haiti" OR "Honduras" OR "Hungary" OR "India" OR "Maldives" OR "Indonesia" OR "Iran" OR "Iraq" OR "Isle of Man" OR "Jamaica" OR "Jordan" OR "Kazakhstan" OR "Kazakh" OR "Kenya" OR "Kiribati" OR "Korea" OR "Kosovo" OR "Kyrgyzstan" OR "Kirghizia" OR "Kyrgyz Republic" OR "Kirghiz" OR "Kirgizstan" OR "Lao PDR" OR "Laos" OR "Latvia" OR "Lebanon" OR "Lesotho" OR "Basutoland" OR "Liberia" OR "Libya" OR "Lithuania")

6. AB("developing country" OR "developing countries" OR "developing nation" OR "developing nations" OR "developing population" OR "developing populations" OR "developing world" OR "less developed country" OR "less developed countries" OR "less developed nation" OR "less developed nations" OR "less developed population" OR "less developed populations" OR "less developed world" OR "lesser developed country" OR "lesser developed countries" OR "lesser developed nation" OR "lesser developed nations" OR "lesser developed population" OR "lesser developed populations" OR "lesser developed world" OR "under developed country" OR "under developed countries" OR "under developed nation" OR "under developed nations" OR "under developed population" OR "under developed populations" OR "under developed world" OR "underdeveloped country" OR "underdeveloped countries" OR "underdeveloped nation" OR "underdeveloped nations" OR "underdeveloped population" OR "underdeveloped populations" OR "underdeveloped world" OR "middle income country" OR "middle income countries" OR "middle income nation" OR "middle income nations" OR "middle income population" OR "middle income populations" OR "low income country" OR "low income countries" OR "low income nation" OR "low income nations" OR "low income population" OR "low income populations" OR "lower income country" OR "lower income countries" OR "lower income nation" OR "lower income nations" OR "lower income population" OR "lower income populations" OR "underserved country" OR "underserved countries" OR "underserved nation" OR "underserved nations" OR "underserved population" OR "underserved populations" OR "underserved world" OR "under served country" OR "under served countries" OR "under served nation" OR "under served nations" OR "under served population" OR "under served populations" OR "under served world" OR "deprived country" OR "deprived countries" OR "deprived nation" OR "deprived nations" OR "deprived population" OR "deprived populations" OR "deprived world" OR "poor country" OR "poor countries" OR "poor nation" OR "poor nations" OR "poor population" OR "poor populations" OR "poor world" OR "poorer country" OR "poorer countries" OR "poorer nation" OR "poorer nations" OR "poorer population" OR "poorer populations" OR "poorer world" OR "developing economy" OR "developing economies" OR "less developed economy" OR "less developed economies" OR "lesser developed economy" OR "lesser developed economies" OR "under developed economy" OR "under developed economies" OR "underdeveloped economy" OR "underdeveloped economies" OR "middle income economy" OR "middle income economies" OR "low income economy" OR "low income economies" OR "lower income economy" OR "lower income economies" OR "low gdp" OR "low gnp" OR "low gross domestic" OR "low gross national" OR "lower gdp" OR "lower gnp" OR "lower gross domestic" OR "lower gross national" OR "lami" OR "lami countries" OR "transitional country" OR "transitional countries")
7. TI("developing country" OR "developing countries" OR "developing nation" OR "developing nations" OR "developing population" OR "developing populations" OR "developing world" OR "less developed country" OR "less developed countries" OR "less developed nation" OR "less developed nations" OR "less developed population" OR "less developed populations" OR "less developed world" OR "lesser developed country" OR "lesser developed countries" OR "lesser developed nation" OR "lesser developed nations" OR "lesser developed population" OR "lesser developed populations" OR "lesser developed world" OR "under developed country" OR "under developed countries" OR "under developed nation" OR "under developed nations" OR "under

developed population" OR "under developed populations" OR "under developed world" OR "underdeveloped country" OR "underdeveloped countries" OR "underdeveloped nation" OR "underdeveloped nations" OR "underdeveloped population" OR "underdeveloped populations" OR "underdeveloped world" OR "middle income country" OR "middle income countries" OR "middle income nation" OR "middle income nations" OR "middle income population" OR "middle income populations" OR "low income country" OR "low income countries" OR "low income nation" OR "low income nations" OR "low income population" OR "low income populations" OR "lower income country" OR "lower income countries" OR "lower income nation" OR "lower income nations" OR "lower income population" OR "lower income populations" OR "underserved country" OR "underserved countries" OR "underserved nation" OR "underserved nations" OR "underserved population" OR "underserved populations" OR "underserved world" OR "underserved country" OR "underserved countries" OR "underserved nation" OR "underserved nations" OR "underserved population" OR "underserved populations" OR "underserved world" OR "deprived country" OR "deprived countries" OR "deprived nation" OR "deprived nations" OR "deprived population" OR "deprived populations" OR "deprived world" OR "poor country" OR "poor countries" OR "poor nation" OR "poor nations" OR "poor population" OR "poor populations" OR "poor world" OR "poorer country" OR "poorer countries" OR "poorer nation" OR "poorer nations" OR "poorer population" OR "poorer populations" OR "poorer world" OR "developing economy" OR "developing economies" OR "less developed economy" OR "less developed economies" OR "lesser developed economy" OR "lesser developed economies" OR "under developed economy" OR "under developed economies" OR "underdeveloped economy" OR "underdeveloped economies" OR "middle income economy" OR "middle income economies" OR "low income economy" OR "low income economies" OR "lower income economy" OR "lower income economies" OR "low gdp" OR "low gnp" OR "low gross domestic" OR "low gross national" OR "lower gdp" OR "lower gnp" OR "lower gross domestic" OR "lower gross national" OR "lami" OR "lami countries" OR "third world" OR "lami country" OR "lami countries" OR "transitional country" OR "transitional countries")

Combined results: 248 (Limited to 2008-2018)

Ovid Global Health

Concept 1 mHealth 30,622 Results limited to 2008-2018

1. exp telemedicine/ or exp telephones/ or exp mobile telephones/ or exp information technology/
2. ("cellular " or "wearable" or "digital").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes] AND ("technology" or "technologies").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
3. ("cellular" or "mobile" or "phone" or "smart" or "text" or "digital" or "electronic" OR "interactive" OR "translation" OR "software" OR "tablet").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes] AND ("app" or "apps" or "application" or "applications" or "alert" or "alerts" or "reminder" or "reminders").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
4. ("ipad" or "mobile device" or "mobile devices" or "SMS" or "short message service" or "text message" or "text-message" or "text messages" or "text-messages" or "text messaging" or "text-messaging" or "texting" or "textings" or "text contact" or "text contacts" or "interactive voice response" or "smartphone" or "smartphones" or "iphone" or "iphones" or "android" or "androids" or "mHealth" or "eHealth" or "information technology" or "information technologies" or "communication technology" or "communication technologies" or "telemedicine" or "telehealth" or "mobile" or "digital health" or "telephone" or "phone" or "phones" or "telephone" or "telephones").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]

Concept 2 Community Health Workers 12,456 Results limited to 2008-2018

1. exp community health workers/ or exp midwives/ or exp traditional birth attendants/
2. ("community health" or "village health").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]AND ("worker" or "workers" or "staff" or "staffing" or "personnel" or "agent" or "agents" or "volunteer" or "volunteers" or "aide" or "aides" or "auxiliary" or "auxiliaries"

or "helper" or "helpers").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]

3. ("community health workers" or "community health worker" or "community health workers" or "CHW" or "CHWs" or "community health aide" or "community health aides" or "family planning personnel" or "midwifery" or "traditional birth attendant" or "traditional birth attendants" or "skilled birth attendant" or "skilled birth attendants" or "frontline worker" or "frontline workers" or "health worker" or "health workers" or "lay worker" or "lay workers" or "village health worker" or "village health workers" or "VHW" or "VHWs" or "midwife" or "midwives" or "barefoot doctors" or "barefoot doctor" or "health auxiliary" or "health auxiliaries" or "peer health worker" or "peer health workers" or "medical auxiliary" or "medical auxiliaries" or "health provider" or "health providers" or "lay counselor" or "lay counselors" or "lady health worker" or "lady health workers" or "LHW" or "LHWs" or "lay educator" or "lay educators" or "Activista" or "activistas" or "Agente comunitario de salud" or "agentes comunitarios de salud" or "Anganwadi" or "accredited social health activist" or "accredited social health activists" or "ASHA" or "ASHAs" or "Animatrice" or "animatrices" or "Barangay health worker" or "Barangay Health Workers" or "Basic health worker" or "basic health workers" or "Brigadista" or "brigadistas" or "Colaborador voluntario" or "Colaboradores voluntarios" or "Community drug distributor" or "community drug distributors" or "Community health agent" or "community health agents" or "Community health promoter" or "community health promoters" or "Community health representative" or "community health representatives" or "Community health volunteer" or "community health volunteers" or "Community nutrition worker" or "community nutrition workers" or "community nutrition volunteer" or "community nutrition volunteers" or "Community resource person" or "community resource persons" or "Female community health volunteer" or "female community health volunteers" or "Female multipurpose health worker" or "female multipurpose health workers" or "Health promoter" or "health promoters" or "Kader" or "kaders" or "Maternal and child health worker" or "maternal and child health workers" or "Monitora" or "monitoras" or "Mother coordinator" or "mother coordinators" or "Outreach educator" or "outreach educators" or "Promotora" or "Promotoras" or "Rural health motivator" or "rural health motivators" or "Shastho shebika" or "Shasthya Shebika" or "Shasthya Shebikas" or "Sevika" or "sevikas" or "Village health helper" or "village health helpers" or "Village drug-kit manager" or "village drug-kit managers" or "Saksham Sahaya" or "Saksham Sahayaks" or "Raedat" or "Raedat Refiat" or "Accompagnateurs" or "Accompagnateur" or "Behvarz" or "behvarzan" or "Dai" or "Dais" or "Bidan Kampong" or "bidan kampungs" or "bidan kampong" or "agents de santé" or "agent de santé").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]

Concept 3: LMIC filter 597625 (Limited to 2008-2018)

1. Developing Countries/ or Africa/ or Africa South of the Sahara/ or Central Africa/ or East Africa/ or Southern Africa/ or West Africa/ or Asia/ or Central Asia/ or South east asia/ or West asia/ or Caribbean/ or West Indies/ or South America/ or Latin America/ or Central America/ or Afghanistan/ or Albania/ or Algeria/ or American Samoa/ or Angola/ or "Antigua and Barbuda"/ or Argentina/ or Armenia/ or Azerbaijan/ or Bahrain/ or Bangladesh/ or Barbados/ or Benin/ or Byelarus/ or Belize/ or Bhutan/ or Bolivia/ or Bosnia-Herzegovina/ or Botswana/ or Brazil/ or Bulgaria/ or Burkina Faso/ or Burundi/ or Cambodia/ or Cameroon/ or Cape Verde/ or Central African Republic/ or Chad/ or Chile/ or China/ or Colombia/ or Comoros/ or Congo/ or Costa Rica/ or Cote d'Ivoire/ or Croatia/ or Cuba/ or Cyprus/ or Czechoslovakia/ or Czech Republic/ or Slovakia/ or Djibouti/ or "Democratic Republic of the Congo"/ or Dominica/ or Dominican Republic/ or East Timor/ or Ecuador/ or Egypt/ or El Salvador/ or Eritrea/ or Estonia/ or Ethiopia/ or Fiji/ or Gabon/ or Gambia/ or Ghana/ or Greece/ or Grenada/ or Guatemala/ or Guinea/ or Guinea-Bissau/ or Guam/ or Guyana/ or Haiti/ or Honduras/ or Hungary/ or India/ or Indonesia/ or Iran/ or Iraq/ or Jamaica/ or Jordan/ or Kazakhstan/ or Kenya/ or Korea/ or Kosovo/ or Kyrgyzstan/ or Laos/ or Latvia/ or Lebanon/ or Lesotho/ or Liberia/ or Libya/ or Lithuania/ or Macedonia/ or Madagascar/ or Malaysia/ or Malawi/ or Mali/ or Malta/ or Mauritania/ or Mauritius/ or Mexico/ or Micronesia/ or Middle East/ or Moldova/ or Mongolia/ or Montenegro/ or Morocco/ or Mozambique/ or Myanmar/ or Namibia/ or Nepal/ or Netherlands Antilles/ or New Caledonia/ or Nicaragua/ or Niger/ or Nigeria/ or Oman/ or Pakistan/ or Palau/ or Panama/ or Papua New Guinea/ or Paraguay/ or Peru/ or Philippines/ or Poland/ or Portugal/ or Puerto Rico/ or Romania/

or Russia/ or Rwanda/ or "Saint Kitts and Nevis"/ or Saint Lucia/ or "Saint Vincent and the Grenadines"/ or Samoa/ or Saudi Arabia/ or Senegal/ or Serbia/ or Montenegro/ or Seychelles/ or Sierra Leone/ or Slovenia/ or Sri Lanka/ or Somalia/ or South Africa/ or Sudan/ or Suriname/ or Swaziland/ or Syria/ or Tajikistan/ or Tanzania/ or Thailand/ or Togo/ or Tonga/ or "Trinidad and Tobago"/ or Tunisia/ or Turkey/ or Turkmenistan/ or Uganda/ or Ukraine/ or Uruguay/ or USSR/ or Uzbekistan/ or Vanuatu/ or Venezuela/ or Vietnam/ or Yemen/ or Yugoslavia/ or Zambia/ or Zimbabwe/

2. ("Africa" or "northern Africa" or "Africa South of the Sahara" or "central Africa" or "eastern Africa" or "western Africa" or "southern Africa" or "Asia" or "central asia" or "southeast Asia" or "western Asia" or "Caribbean" or "Caribbean Region" or "West Indies" or "South America" or "Latin America" or "Central America" or "Afghanistan" or "Albania" or "Algeria" or "Angola" or "Antigua" or "american samoa" or "Barbuda" or "Antigua and Barbuda" or "Argentina" or "Armenia" or "Armenian" or "Aruba" or "Azerbaijan" or "Bahrain" or "Bangladesh" or "Barbados" or "Benin" or "Byelarus" or "Byelorussian" or "Belarus" or "Belorussian" or "republic of Belarus" or "Belorussia" or "Belize" or "Bhutan" or "Bolivia" or "Bosnia" or "Herzegovina" or "bosnia and Herzegovina" or "Hercegovina" or "Botswana" or "Brasil" or "Brazil" or "Bulgaria" or "Burkina Faso" or "Burkina Fasso" or "Upper Volta" or "Burundi" or "Urundi" or "Cambodia" or "Khmer Republic" or "Kampuchea" or "Cameroon" or "Cameroons" or "Cameron" or "Cape Verde" or "cabo verde" or "Central African Republic" or "Chad" or "Chile" or "China" or "Colombia" or "Comoros" or "Comoro Islands" or "Comores" or "Mayotte" or "Congo" or "Democratic Republic of the Congo" or "Zaire" or "Costa Rica" or "Cote d'Ivoire" or "Ivory Coast" or "Croatia" or "Cuba" or "Cyprus" or "Czechoslovakia" or "Czech Republic" or "Slovakia" or "Slovak Republic" or "Djibouti" or "French Somaliland" or "Dominica" or "Dominican Republic" or "East Timor" or "(East AND Timur)" or "Timor Leste" or "Ecuador" or "Egypt" or "United Arab Republic" or "El Salvador" or "Eritrea" or "Estonia" or "Ethiopia" or "Fiji" or "Gabon" or "Gabonese Republic" or "Gambia" or "Gaza" or "Georgia Republic" or "Georgia (republic)" or "Georgian Republic" or "Ghana" or "Gold Coast" or "Greece" or "Grenada" or "Guatemala" or "Guinea" or "guinea-bissau" or "Guam" or "Guiana" or "Guyana" or "Haiti" or "Honduras" or "Hungary" or "India" or "Maldives" or "Indonesia" or "Iran" or "Iraq" or "Isle of Man" or "Jamaica" or "Jordan" or "Kazakhstan" or "Kazakh" or "Kenya" or "Kiribati" or "Korea" or "Kosovo" or "Kyrgyzstan" or "Kirghizia" or "Kyrgyz Republic" or "Kirghiz" or "Kirgizstan" or " lao pdr " or "Laos" or "Latvia" or "Lebanon" or "Lesotho" or "Basutoland" or "Liberia" or "Libya" or "Lithuania" or "Macedonia" or "Madagascar" or "Malagasy Republic" or "Malaysia" or "Malaya" or "Malay" or "Sabah" or "Sarawak" or "Malawi" or "Nyasaland" or "Mali" or "Malta" or "Marshall Islands" or "Mauritania" or "Mauritius" or "Agalega Islands" or "Mexico" or "Micronesia" or "Middle East" or "Moldova" or "Moldovia" or "Moldovian" or "Mongolia" or "Montenegro" or "Morocco" or "Ifni" or "Mozambique" or "Myanmar" or "Myanma" or "Burma" or "Namibia" or "Nepal" or "Netherlands Antilles" or "New Caledonia" or "Nicaragua" or "Niger" or "Nigeria" or "Northern Mariana Islands" or "Oman" or "Muscat" or "Pakistan" or "Palau" or "Palestine" or "Panama" or "papua new guinea" or "Paraguay" or "Peru" or "Philippines" or "Philipines" or "Phillipines" or "Phillippines" or "Poland" or "Portugal" or "Puerto Rico" or "Romania" or "Rumania" or "Roumania" or "Russia" or "Russia (Pre-1917)" or "Russian" or "Rwanda" or "Ruanda" or "Saint Kitts" or "St Kitts" or "Nevis" or "Saint Kitts and Nevis" or "Saint Lucia" or "St Lucia" or "Saint Vincent" or "St Vincent" or "Grenadines" or "Saint Vincent and the Grenadines" or "Samoa" or "Samoan Islands" or "Navigator Island" or "Navigator Islands" or "Sao Tome" or "Saudi Arabia" or "Senegal" or "Serbia" or "Montenegro" or "Seychelles" or "south Africa" or "Sierra Leone" or "Slovenia" or "Sri Lanka" or "Ceylon" or "Solomon Islands" or "Somalia" or "Sudan" or "Suriname" or "Surinam" or "Swaziland" or "Syria" or "Tajikistan" or "Tadzhikistan" or "Tadjikistan" or "Tadzhik" or "Tanzania" or "Thailand" or "Togo" or "Togolese Republic" or "Tonga" or "Trinidad" or "Tobago" or "Trinidad and Tobago" or "Tunisia" or "Turkey" or "Turkmenistan" or "Turkmen" or "Uganda" or "Ukraine" or "Uruguay" or "USSR" or "Soviet Union" or "Union of Soviet Socialist Republics" or "Uzbekistan" or "Uzbek" or "Vanuatu" or "New Hebrides" or "Venezuela" or "Vietnam" or "Viet Nam" or "West Bank" or "Yemen" or "Yugoslavia" or "Zambia" or "Zimbabwe" or "Rhodesia").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]

3. ("developing country" or "developing countries" or "developing nation" or "developing nations" or "developing population" or "developing populations" or "developing world" or "less developed country" or "less developed countries" or "less developed nation" or "less developed nations" or "less developed world" or "lesser developed countries" or "lesser developed nations" or "under developed country" or "under developed countries" or "under developed nations" or "under developed world" or "underdeveloped country" or "underdeveloped countries" or "underdeveloped nations" or "underdeveloped population" or "underdeveloped world" or "middle income country" or "middle income countries" or "middle income nation" or "middle income nations" or "middle income population" or "middle income populations" or "low income country" or "low income countries" or "low income nation" or "low income nations" or "low income population" or "low income populations" or "lower income country" or "lower income countries" or "lower income nations" or "lower income population" or "lower income populations" or "underserved countries" or "underserved nations" or "underserved population" or "underserved populations" or "under served population" or "under served populations" or "deprived countries" or "deprived population" or "deprived populations" or "poor country" or "poor countries" or "poor nation" or "poor nations" or "poor population" or "poor populations" or "poor world" or "poorer countries" or "poorer nations" or "poorer population" or "poorer populations" or "developing economy" or "developing economies" or "less developed economy" or "less developed economies" or "underdeveloped economies" or "middle income economies" or "low income economy" or "low income economies" or "low gdp" or "low gnp" or "low gross domestic" or "low gross national" or "lower gdp" or "lower gross domestic" or "lami" or "lamic" or "third world" or "lami country" or "lami countries" or "transitional country" or "transitional countries").mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]

Combined result: 388

Cochrane 4/1/2018

Concept 1 mHealth 18,004 results limited to 2008-2018 publication years

#1 MeSH descriptor: [Telemedicine] explode all trees

#2 MeSH descriptor: [Information Technology] explode all trees

#3 MeSH descriptor: [Telephone] explode all trees

#4 MeSH descriptor: [Mobile Applications] explode all trees

#5 "ipad" or "mobile device" or "mobile devices" or "SMS" or "short message service" or "text message" or "text-message" or "text messages" or "text-messages" or "text messaging" or "text-messaging" or "texting" or "textings" or "text contact" or "text contacts" or "interactive voice response" or "smartphone" or "smartphones" or "iphone" or "iphones" or "android" or "androids" or "mHealth" or "eHealth" or "information technology" or "information technologies" or "communication technology" or "communication technologies" or "telemedicine" or "telehealth" or "mobile" or "digital health" or "telephone" or "phone" or "phones" or "telephone" or "telephones":ti,ab,kw (Word variations have been searched)

#6 "app" or "apps" or "application" or "applications" or "alert" or "alerts" or "reminder" or "reminders":ti,ab,kw (Word variations have been searched)

#7 "cellular" or "mobile" or "phone" or "smart" or "text" or "digital" or "electronic" or "interactive" or "translation" or "software" or "tablet":ti,ab,kw (Word variations have been searched)

#8 "cellular" or "wearable" or "digital":ti,ab,kw (Word variations have been searched)

#9 "technology" or "technologies":ti,ab,kw (Word variations have been searched)

#7 #7 AND #6

#10 #9 AND #8

#11 #1 or #2 or #3 or #4 or #9 or #10

Concept 2 Community Health Worker 2527 results limited to 2008-2018 publication years

#1 MeSH descriptor: [Community Health Workers] explode all trees

#2 MeSH descriptor: [Midwifery] explode all trees

#3 "community health" or "village health"

#4 "worker" or "workers" or "staff" or "staffing" or "personnel" or "agent" or "agents" or "volunteer" or "volunteers" or "aide" or "aides" or "auxiliary" or "auxiliaries" or "helper" or "helpers"

#5 "community health workers" or "community health worker" or "community health workers" or "CHW" or "CHWs" or "community health aide" or "community health aides" or "family planning personnel" or "midwifery" or "traditional birth attendant" or "traditional birth attendants" or "skilled birth attendant" or

"skilled birth attendants" or "frontline worker" or "frontline workers" or "health worker" or "health workers" or "lay worker" or "lay workers" or "village health worker" or "village health workers" or "VHW" or "VHWs" or "midwife" or "midwives" or "barefoot doctors" or "barefoot doctor" or "health auxiliary" or "health auxiliaries" or "peer health worker" or "peer health workers" or "medical auxiliary" or "medical auxiliaries" or "health provider" or "health providers" or "lay counselor" or "lay counselors" or "lady health worker" or "lady health workers" or "LHW" or "LHWs" or "lay educator" or "lay educators" or "Activista" or "activistas" or "Agente comunitario de salud" or "agentes comunitarios de salud" or "Anganwadi" or "accredited social health activist" or "accredited social health activists" or "ASHA" or "ASHAs" or "Animatrice" or "animatrices" or "Barangay health worker" or "Barangay Health Workers" or "Basic health worker" or "basic health workers" or "Brigadista" or "brigadistas" or "Colaborador voluntario" or "Colaboradores voluntarios" or "Community drug distributor" or "community drug distributors" or "Community health agent" or "community health agents" or "Community health promoter" or "community health promoters" or "Community health representative" or "community health representatives" or "Community health volunteer" or "community health volunteers" or "Community nutrition worker" or "community nutrition workers" or "community nutrition volunteer" or "community nutrition volunteers" or "Community resource person" or "community resource persons" or "Female multipurpose health volunteer" or "female multipurpose health volunteers" or "Female multipurpose health worker" or "female multipurpose health workers" or "Health promoter" or "health promoters" or "Kader" or "kaders" or "Maternal and child health worker" or "maternal and child health workers" or "Monitora" or "Mother coordinator" or "mother coordinators" or "Outreach educator" or "outreach educators" or "Promotora" or "Promotoras" or "Rural health motivator" or "rural health motivators" or "Shastho shebika" or "Shasthya Shebika" or "Shasthya Shebikas" or "Sevika" or "sevikas" or "Village health helper" or "village health helpers" or "Village drug-kit manager" or "village drug-kit managers" or "Saksham Sahaya" or "Saksham Sahayaks" or "Raedat" or "Raedat Refiat" or "Accompagnateurs" or "Accompagnateur" or "Behvarz" or "behvarzan" or "Dai" or "Dais" or "Bidan Kampong" or "bidan kampungs" or "bidan kampong" or "agents de santé" or "agent de santé":ti,ab,kw (Word variations have been searched)

#15 #12 or #13 or #14

Concept 3: LMIC 41,528 results

#1 Romania or Rumania or Roumania or Russia or Russian or Rwanda or Ruanda or "Saint Kitts" or "St Kitts" or Nevis or "Saint Lucia" or "St Lucia" or "Saint Vincent" or "St Vincent" or Grenadines or Samoa or "Samoan Islands" or "Navigator Island" or "Navigator Islands" or "Sao Tome" or "Saudi Arabia" or Senegal or Serbia or Montenegro or Seychelles or "Sierra Leone" or Slovenia or "Sri Lanka" or Ceylon or "Solomon Islands" or Somalia or Sudan or Suriname or Surinam or Swaziland or Syria or Tajikistan or Tadjikistan or Tadjikistan or Tadjik or Tanzania or Thailand or Togo or "Togolese Republic" or Tonga or Trinidad or Tobago or Tunisia or Turkey or Turkmenistan or Turkmen or Uganda or Ukraine or Uruguay or USSR or "Soviet Union" or "Union of Soviet Socialist Republics" or Uzbekistan or Uzbek or Vanuatu or "New Hebrides" or Venezuela or Vietnam or "Viet Nam" or "West Bank" or Yemen or Yugoslavia or Zambia or Zimbabwe or Rhodesia:ti,ab,kw (Word variations have been searched)

#2 Macedonia or Madagascar or "Malagasy Republic" or Malaysia or Malaya or Malay or Sabah or Sarawak or Malawi or Nyasaland or Mali or Malta or "Marshall Islands" or Mauritania or Mauritius or "Agalega Islands" or Mexico or Micronesia or "Middle East" or Moldova or Moldavia or Moldovan or Mongolia or Montenegro or Morocco or Ifni or Mozambique or Myanmar or Myanma or Burma or Namibia or Nepal or "Netherlands Antilles" or "New Caledonia" or Nicaragua or Niger or Nigeria or "Northern Mariana Islands" or Oman or Muscat or Pakistan or Palau or Palestine or Panama or Paraguay or Peru or Philippines or Philipines or Phillipines or Phillippines or Poland or Portugal or "Puerto Rico":ti,ab,kw (Word variations have been searched)

#3 Djibouti or "French Somaliland" or Dominica or "Dominican Republic" or "East Timor" or "East Timur" or "Timor Leste" or Ecuador or Egypt or "United Arab Republic" or "El Salvador" or Eritrea or Estonia or Ethiopia or Fiji or Gabon or "Gabonese Republic" or Gambia or Gaza or Georgia or Georgian or Ghana or "Gold Coast" or Greece or Grenada or Guatemala or Guinea or Guam or Guiana or Guyana or Haiti or Honduras or Hungary or India or Maldives or Indonesia or Iran or Iraq or "Isle of Man" or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or "Kyrgyz Republic" or Kirghiz or Kirgizstan or "Lao PDR" or Laos or Latvia or Lebanon or Lesotho or Basutoland or Liberia or Libya or Lithuania:ti,ab,kw (Word variations have been searched)

#4 Afghanistan or Albania or Algeria or Angola or Antigua or Barbuda or Argentina or Armenia or Armenian or Aruba or Azerbaijan or Bahrain or Bangladesh or Barbados or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Hercegovina or Botswana or Brasil or Brazil or Bulgaria or "Burkina Faso" or "Burkina Fasso" or "Upper Volta" or Burundi or Urundi or Cambodia or "Khmer Republic" or Kampuchea or Cameroon or Cameroons or Cameron or Camerons or "Cape Verde" or "Central African Republic" or Chad or Chile or China or Colombia or Comoros or "Comoro Islands" or Comores or Mayotte or Congo or Zaire or "Costa Rica" or "Cote d'Ivoire" or "Ivory Coast" or Croatia or Cuba or Cyprus or Czechoslovakia or "Czech Republic" or Slovakia or "Slovak Republic":ti,ab,kw (Word variations have been searched)

#5

Combined: 142

Global Index Medicus

Concept 1: mHealth 23,142 results limited to 2008-2018

1. (ab:(("cellular" or "mobile" or "phone" or "smart" or "text" or "digital" or "electronic" or "interactive" or "translation" or "software" or "tablet")) AND (ab:(("app" or "apps" or "application" or "applications" or "alert" or "alerts" or "reminder" or "reminders"))))
2. (ab:(("cellular" or "wearable" or "digital")) AND (ab:(("technology" or "technologies"))))
3. "Community Health Workers" OR "Telemedicine" OR "Midwifery" OR "mobile applications"
4. ab: ("ipad" or "mobile device" or "mobile devices" or "SMS" or "short message service" or "text message" or "text-message" or "text messages" or "text-messages" or "text messaging" or "text-messaging" or "texting" or "textings" or "text contact" or "text contacts" or "interactive voice response" or "smartphone" or "smartphones" or "iphone" or "iphones" or "android" or "androids" or "mHealth" or "eHealth" or "information technology" or "information technologies" or "communication technology" or "communication technologies" or "telemedicine" or "telehealth" or "mobile" or "digital health" or "telephone" or "phone" or "phones" or "telephone" or "telephones")

FINAL: ((ab:(("cellular" or "mobile" or "phone" or "smart" or "text" or "digital" or "electronic" or "interactive" or "translation" or "software" or "tablet")) AND (ab:(("app" or "apps" or "application" or "applications" or "alert" or "alerts" or "reminder" or "reminders")))) OR ((ab:(("cellular" or "wearable" or "digital")) AND (ab:(("technology" or "technologies")))) OR (mh:("Telemedicine" OR "Telephone" OR "Cell Phones" or "Mobile applications")) OR (ab:(("ipad" or "mobile device" or "mobile devices" or "SMS" or "short message service" or "text message" or "text-message" or "text messages" or "text-messages" or "text messaging" or "text-messaging" or "texting" or "textings" or "text contact" or "text contacts" or "interactive voice response" or "smartphone" or "smartphones" or "iphone" or "iphones" or "android" or "androids" or "mHealth" or "eHealth" or "information technology" or "information technologies" or "communication technology" or "communication technologies" or "telemedicine" or "telehealth" or "mobile" or "digital health" or "telephone" or "phone" or "phones" or "telephone" or "telephones")) limited to WPRIM (Western Pacific) LILACS (Americas) IMSEAR (South-EastAsia) IMEMR (Eastern Mediterranean), WHOLIS (KMS), AIM (Africa)

Concept 2: Community Health Workers 53310 results

(ab:(("community health workers" or "community health worker" or "community health workers" or "CHW" or "CHWs" or "community health aide" or "community health aides" or "family planning personnel" or "midwifery" or "traditional birth attendant" or "traditional birth attendants" or "skilled birth attendant" or "skilled birth attendants" or "frontline worker" or "frontline workers" or "health worker" or "health workers" or "lay worker" or "lay workers" or "village health worker" or "village health workers" or "VHW" or "VHWs" or "midwife" or "midwives" or "barefoot doctors" or "barefoot doctor" or "health auxiliary" or "health auxiliaries" or "peer health worker" or "peer health workers" or "medical auxiliary" or "medical auxiliaries" or "health provider" or "health providers" or "lay counselor" or "lay counselors" or "lady health worker" or "lady health workers" or "LHW" or "LHWs" or "lay educator" or "lay educators" or "Activista" or "activistas" or "Agente comunitario de salud" or "agentes comunitarios de salud" or "Anganwadi" or "accredited social health activist" or "accredited social health activists" or "ASHA" or "ASHAs" or "Animatrice" or "animatrices" or "Barangay health worker" or "Barangay Health Workers" or "Basic health worker" or "basic health workers" or "Brigadista" or "brigadistas" or "Colaborador voluntario" or "Colaboradores voluntarios" or "Community drug distributor" or "community drug distributors" or "Community health agent" or "community health agents" or "Community health promoter" or "community health promoters" or "Community health representative" or "community health representatives" or "Community health volunteer" or "community health volunteers" or "Community nutrition worker" or "community nutrition

workers" or "community nutrition volunteer" or "community nutrition volunteers" or "Community resource person" or "community resource persons" or "Female community health volunteer" or "female community health volunteers" or "Female multipurpose health worker" or "female multipurpose health workers" or "Health promoter" or "health promoters" or "Kader" or "kaders" or "Maternal and child health worker" or "maternal and child health workers" or "Monitora" or "monitoras" or "Mother coordinator" or "mother coordinators" or "Outreach educator" or "outreach educators" or "Promotora" or "Promotoras" or "Rural health motivator" or "rural health motivators" or "Shastho shebika" or "Shasthya Shebika" or "Shasthya Shebikas" or "Sevika" or "sevikas" or "Village health helper" or "village health helpers" or "Village drug-kit manager" or "village drug-kit managers" or "Saksham Sahaya" or "Saksham Sahayaks" or "Raedat" or "Raedat Refiat" or "Accompagnateurs" or "Accompagnateur" or "Behvarz" or "behvarzan" or "Dai" or "Dais" or "Bidan Kampong" or "bidan kampungs" or "bidan kampong" or "agents de santé" or "agent de santé")) OR (mh:(Midwifery)) OR (mh:(Community Health Worker))

Combined: 60 limited 2008-2018

(ab:(("cellular" or "mobile" or "phone" or "smart" or "text" or "digital")) AND (ab:(("app" or "application" or "applications" or "alert" or "alerts" or "reminder" or "reminders")) OR ((ab:(("cellular" or "wearable" or "digital")) AND (ab:(("technology" or "technologies")))) OR (mh:("Telemedicine" OR "Telephone" OR "Cell Phones")))) OR (ab:(("portable cellular" or "transportable cellular" or "mobile device" or "mobile devices" or "SMS" or "short message service" or "text message" or "text-message" or "text messages" or "text-messages" or "text messaging" or "text-messaging" or "texting" or "textings" or "text contact" or "text contacts" or "interactive voice response" or "smartphone" or "smartphones" or "iphone" or "iphones" or "android" or "androids" or "mHealth" or "eHealth" or "information technology" or "information technologies" or "communication technology" or "communication technologies" or "telemedicine" or "telehealth" or "mobile" or "digital health" or "telephone" or "phone" or "phones" or "telephone" or "telephones")))) AND (ab:(("community health workers" or "community health worker" or "community health workers" or "CHW" or "CHWs" or "community health aid" or "community health aides" or "family planning personnel" or "midwifery" or "traditional birth attendant" or "traditional birth attendants" or "skilled birth attendant" or "skilled birth attendants" or "frontline worker" or "frontline workers" or "health worker" or "health workers" or "lay worker" or "lay workers" or "village health worker" or "village health workers" or "VHW" or "VHWs" or "midwife" or "midwives" or "barefoot doctors" or "barefoot doctor" or "health auxiliary" or "health auxiliaries" or "peer health worker" or "peer health workers" or "medical auxiliary" or "medical auxiliaries" or "health provider" or "health providers" or "lay counselor" or "lay counselors" or "lady health worker" or "lady health workers" or "LHW" or "LHWs" or "lay educator" or "lay educators" or "Activista" or "activistas" or "Agente comunitario de salud" or "agentes comunitarios de salud" or "Anganwadi" or "accredited social health activist" or "accredited social health activists" or "ASHA" or "ASHAs" or "Animatrice" or "animatrices" or "Barangay health worker" or "Barangay Health Workers" or "Basic health worker" or "basic health workers" or "Brigadista" or "brigadistas" or "Colaborador voluntario" or "Colaboradores voluntarios" or "Community drug distributor" or "community drug distributors" or "Community health agent" or "community health agents" or "Community health promoter" or "community health promoters" or "Community health representative" or "community health representatives" or "Community health volunteer" or "community health volunteers" or "Community nutrition worker" or "community nutrition volunteers" or "Community resource person" or "community resource persons" or "Female community health volunteer" or "female community health volunteers" or "Female multipurpose health worker" or "female multipurpose health workers" or "Health promoter" or "health promoters" or "Kader" or "kaders" or "Maternal and child health worker" or "maternal and child health workers" or "Monitora" or "Mother coordinator" or "mother coordinators" or "Outreach educator" or "outreach educators" or "Promotora" or "Promotoras" or "Rural health motivator" or "rural health motivators" or "Shastho shebika" or "Shasthya Shebika" or "Shasthya Shebikas" or "Sevika" or "sevikas" or "Village health helper" or "village health helpers" or "Village drug-kit manager" or "village drug-kit managers" or "Saksham Sahaya" or "Saksham Sahayaks" or "Raedat" or "Raedat Refiat" or "Accompagnateurs" or "Accompagnateur" or "Behvarz" or "behvarzan" or "Dai" or "Dais" or "Bidan Kampong" or "bidan kampungs" or "bidan kampong" or "agents de santé" or "agent de santé")) OR (mh:(Midwifery)) OR (mh:(Community Health Worker)))

Appendix B: Filters for abstract screening

1. FLHWs:

Auxiliary nurse midwives	Frontline health workers
Accredited social health activist (ASHA)	Lady health workers
Anganwadi	Lay counselors
Barefoot doctors	Lay workers
Community health workers	Medical auxiliaries
Community health agents	Midwives
Community health representatives	Traditional birth attendants
Community drug distributors	Village health workers
Health auxiliaries	

2. Countries:

Afghanistan	Georgia Republic	Pakistan
Albania	Georgian Republic	Palau
Algeria	Ghana	Palestine
Angola	Gold Coast	Panama
Antigua	Greece	Paraguay
Barbuda	Grenada	Peru
Argentina	Guatemala	Philippines
Armenia	Guinea	Philippines
Armenian	Guam	Phillippines
Aruba	Guiana	Phillippines
Azerbaijan	Guyana	Poland
Bahrain	Haiti	Portugal
Bangladesh	Honduras	Puerto Rico
Barbados	Hungary	Romania
Benin	India	Rumania
Byelarus	Maldives	Roumania
Byelorussian	Indonesia	Russia
Belarus	Iran	Russian
Belussian	Iraq	Rwanda
Belussia	Isle of Man	Ruanda
Belize	Jamaica	Saint Kitts
Bhutan	Jordan	St Kitts
Bolivia	Kazakhstan	Nevis
Bosnia	Kazakh	Saint Lucia
Herzegovina	Kenya	St Lucia
Hercegovina	Kiribati	Saint Vincent

Botswana	Korea	St Vincent
Brasil	Kosovo	Grenadines
Brazil	Kyrgyzstan	Samoa
Bulgaria	Kirghizia	Samoa Islands
Burkina Faso	Kyrgyz Republic	Navigator Island
Burkina Fasso	Kirghiz	Sao Tome
Upper Volta	Kirgizstan	Saudi Arabia
Burundi	Lao PDR	Senegal
Urundi	Laos	Serbia
Cambodia	Latvia	Montenegro
Khmer Republic	Lebanon	Seychelles
Kampuchea	Lesotho	Sierra Leone
Cameroon	Basutoland	Slovenia
Cameroons	Liberia	Sri Lanka
Cameron	Libya	Ceylon
Cape Verde	Lithuania	Solomon Islands
Central African Republic	Macedonia	Somalia
Chad	Madagascar	Sudan
Chile	Malagasy Republic	Suriname
China	Malaysia	Surinam
Colombia	Malaya	Swaziland
Comoros	Malay	Syria
Comoro Islands	Sabah	Tajikistan
Comores	Sarawak	Tadzhikistan
Mayotte	Malawi	Tadjikistan
Congo	Nyasaland	Tadzhik
Zaire	Mali	Tanzania
Costa Rica	Malta	Thailand
Cote d'Ivoire	Marshall Islands	Togo
Ivory Coast	Mauritania	Togolese Republic
Croatia	Mauritius	Tonga
Cuba	Agalega Islands	Trinidad
Cyprus	Mexico	Tobago
Czechoslovakia	Micronesia	Tunisia
Czech Republic	Middle East	Turkey
Slovakia	Moldova	Turkmenistan
Slovak Republic	Moldovia	Turkmen
Djibouti	Moldovian	Uganda
French Somaliland	Mongolia	Ukraine
Dominica	Montenegro	Uruguay
Dominican Republic	Morocco	USSR

East Timor	Ifni	Soviet Union
East Timur	Mozambique	Union of Soviet Socialist Republics
Timor Leste	Myanmar	Uzbekistan
Ecuador	Myanma	Uzbek
Egypt	Burma	Vanuatu
United Arab Republic	Namibia	New Hebrides
El Salvador	Nepal	Venezuela
Eritrea	Netherlands Antilles	Vietnam
Estonia	New Caledonia	Viet Nam
Ethiopia	Nicaragua	West Bank
Fiji	Niger	Yemen
Gabon	Nigeria	Yugoslavia
Gabonese Republic	Northern Mariana Islands	Zambia
Gambia	Oman	Zimbabwe
Gaza	Muscat	Rhodesia

3. Digital health tools:

Alerts	mHealth
Androids	Reminder
app	Smartphone
Cellular / Mobile phones	Software
Communication technologies	Telemedicine
eHealth	Text-Messages
Information Technology	Wearable
iPhones	

4. Tool use as defined by the WHO

1. Tools which aim to provide training

Description: Digital delivery of training content to healthcare providers to overcome challenges related to coverage of training for health workers, quality of health services provided (including provider competence and adherence to protocol), and utilization of health services.”

2. Tools which are decision support / aim to improve service delivery

Description: Digital decision support tools to overcome challenges related to quality of health services provided (including provider competence, adherence to protocol, and screening of clients).

3. Digital tools which support capture data

Description: Digital longitudinal client health records for tracking health status and services (also in combinations with decision support; targeted client communication) to overcome challenges related to

follow-up of clients, data quality and reporting, quality of health services provided (including provider competence and adherence to protocol, prioritization and screening of clients).

4. Commodity tracking

Description: Digital strategies for tracking commodity inventory and notifying stock levels in primary care settings to overcome challenges with availability of commodities at point of care

5. FLHW to other provider communication and vice versa

Description: Tools which facilitate and/or enable communication between cadres of FLHWs and other health workers

Can be bi- or uni-directional

6. Patient to FLHW provider communication and vice versa

Description: Digital tools which allow patients to communicate with FLHWs

Can be bi- or uni-directional

7. Alerts and reminders

Appendix C: Data extraction table

	Year	Author/s	Title	Intervention/ program	Objectives	Country (and state/province)	Sample size	Cadre of FLHW	Health service	Disease / practice area	Device	Platform
1												
2												
3												

	Duration of training	Content	Language	Evaluation method / outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design	Stage	Appraisal score
1											
2											
3											

Appendix D: Table with additional information

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Diedhiou, A. et al. (2015)	Successful mLearning pilot in Senegal: Delivering family planning refresher training using interactive voice response and SMS	mLearning system using interactive voice response (IVR) and text messaging on simple mobile phones to provide in-service training to nurses and midwives.	To test the feasibility of using a simple mobile technology to deliver refresher family planning training to providers.	Refresher family planning training (after previous initial family planning training). Spaced education approach - questions and explanations spaced and repeated over time. Alternative to conventional in-service training, not replacement.	Based on initial training and in direct alignment with the Senegal family planning national training curriculum, protocols and international guidelines.	Quantitative (surveys)	90% noted that using the phone for the course was easy or very easy and that they learned the same or more compared with an in-person course. Participants appreciated the ability to determine the pace (60%), convenience (55%), and flexibility to access the course anywhere (40%). Average scores increased significantly after training ($p<0.01$), and despite a slight decline after 10 months still significantly higher than before training ($p<0.01$).	Reliability and variability of cellular networks in remote areas remains a challenge - one third of participants experienced problems with cellular network. Telephone network contract and loading of airtime issues. Platform handling voice interactions (FreeSWITCH), encountered some issues with accessing multiple voice lines at the same time. Some participants noted the 8 weeks duration was too long and that 20 questions were too few considering the time given to complete them. Training via simple mobile phones do not allow for interaction with	IVR mLearning system did not disrupt health workers' service delivery as they answered questions during non-regular working hours (vs. conventional in-service training workshop that requires them to leave their posts for a number of days). System is convenient - ability to determine when and where to access training and pace of completing the course. feasible to deliver course in ± 8 weeks. mLearning systems are well suited to meet emerging needs that require rapid	Global Health: Science and Practice	Quasi-experimental, no control group (pilot)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
								<p>instructor or other participants, perform clinical practice/simulation, or view didactic images - some participants disliked the lack of exercises and demonstrations and inability to ask questions.</p>	<p>dissemination of information to diffusely distributed health workers (e.g. Ebola management) . After initial expenses of development of software and content, costs could be reduced by adaptation, providing orientation at routine meetings and using toll free numbers rather than cell phone contracts. could easily be adapted and adopted to reach low literacy health workers since it relies mostly only on voice and numeric interactions rather than written materials. System can overcome language barriers as training messages can be recorded in any</p>		

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
									language/dialect.		

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Limaye, R. et al. (2015)	Designing eLearning courses to meet the digital literacy needs of healthcare workers in lower- and middle-income countries: Experiences from the Knowledge for Health Project	Digital health platform of evidence-based best practices, standards, and guidelines for basic communication and health interventions along with a comprehensive set of behaviour change communication tools and resources used to improve the knowledge- and skill-based competencies of frontline workers in the areas of health, population, and nutrition.	To improve the knowledge- and skill-based competencies of FLHWs throughout Bangladesh in the areas of health, population, and nutrition.	Supplement knowledge and enhance their counseling activities. Ongoing, interactive.	Behaviour change communication resources, Government of Bangladesh's (GOB) standards for counseling clients, compiled in consultation with GOB, international health agencies and local NGOs.	Mixed methods (quantitative surveys and qualitative interviews and focus groups)	Frontline workers enjoyed using the platform and found the technology easy to use, they used eLearning courses for counseling clients and improving their subject area knowledge and skills. There were substantial increases in knowledge across intervention subject areas from pre-assessment to post-assessment: 30% in knowledge regarding available options for family planning, and 10% increase in knowledge regarding the benefits of exclusive breastfeeding.	Factors such as government buy-in, cost-effectiveness of digital health applications, and in-country capacity to operate these innovations will be important to determine the scalability of eToolkit and eLearning courses for use by all public sector FLHWs.	Planning and development of the platform took into consideration the gaps in digital literacy that frontline workers may face in using the platform, achieved through consultation with local stakeholders and pretesting with FW.	Knowledge Management & E-Learning	Quasi-experimental, no control group (pilot)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Otu, A. et al. (2016)	Using an mHealth tutorial application to change knowledge and attitude of frontline health workers to Ebola virus disease in Nigeria: a before-and-after study	Facilitation of FLHW training to improve emergency preparedness of the health system to contain Ebola outbreak.	To assess the effect of using a tablet computer application to deliver an education intervention to change FLHWs' EVD-related knowledge and attitude in Nigeria. (1. Application effective? 2. effect of intervention on knowledge and attitudes) Hypotheses: i) Info could be delivered at a distance via tablets in context of epidemic ii) tablet-delivered education intervention positively change biomedical knowledge of EVD.	Improving emergency preparedness - component of "Front Line health worker Education and disease Management (FLEM) project". Tablet tutorial. Didactive.	Extend and enhance existing CliniPAK electronic health information systems to disseminate critical information to FHWs in real time. Essential information on EVD. Part of the program.	Quantitative (surveys)	General upward trend in average between pre- and post-tutorial scores. Significant reduction in fear of EVD from 89 to 52%; positive attitudes were reinforced and negative attitudes / perceptions discouraged judging from pre- and post-tutorial scores. More positive response in favour of desirable clinical practices and to prevent spearing of EVD.	Changing age-long cultural practices requires addressing multiple factors from socio-cultural to environmental, economic and structural factors that influence the logic behind people's behaviour. Industrial strike during study prevented some participants from completing all tutorials and surveys.	Effectiveness of application in changing knowledge ascribed to disseminating educational materials in real time combined with convenience of undeterred access to online learning materials. User-friendly nature of the application and regular access to a limitless amount of educational materials, streamed in real time to FHWs, is a strong selling point.	Human Resources for Health	Quasi-experimental, no control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Pimmer, C. et al. (2016)	Supervision on social media: Use and perception of Facebook as a r+C11+D11	Using a Facebook group as a research supervision and distance learning tool over time.	1) How does a group of learners from disadvantaged settings access and accept a social networking space for research supervision? How do these indicators change during and after the intervention? 2) What are the educational uses and the perceived value of Facebook for supervision and learning purposes? How do these indicators change during and after the intervention?	Distance learning. Supervision explained by heutagogy - an emergent theory of self-determined learning that recognises the need for flexible and autonomous learning environments, where students determine their paths of learning while educators provide attendant resources to support these processes. Focus is on development of learner capacity and capability with goal of producing learners who are prepared to deal properly with the unforeseeable complexities of the workplace.	In context of a module focused on developing analytical and research skills for nurses enrolled on a part-time, advanced midwifery programme in rural areas. Online pedagogical support/research supervision.	Mixed methods (quantitative and qualitative surveys)	Significantly higher Facebook access via mobile phone ($p<0.001$) as well as desktop and laptop ($p<0.001$) after intervention. Use of social media platform for learning and supervision was well-received. Ease of use of Facebook on mobile phone significantly increased over time ($p<0.001$), more so than using computers ($p=0.002$). Significant increase in Facebook use for course-related learning through communication with work peers and other learners ($p<0.001$ respectively), and became a more integral part of their educational activities.	[Experienced clinical nurses had very limited research knowledge and experience and limited digital literacy skills]. In addition to technology and connectivity-related challenges, a new gap unfolded within the originally disadvantaged group, especially with respect to age. Need to develop critical social media literacy skills, including competencies and knowledge about risks of revealing sensitive data on social networking sites where boundaries between private and public is porous, and learning about the underlying rationale and business mechanisms of social media applications. [To prevent new gaps from occurring	Accessibility of social networking space as supervision and learning tool. Predominantly positive attitudes towards this form of distance learning. Enhanced and simplified access are of value where there is limited co-presence of teachers and learners. Considered to "low threshold application" (Gilbert, 2002), an information technology that is reliable, accessible, easy to learn, non-intimidating, and inexpensive. Significant increase in use of social networking space beyond supervision setting, and increasing levels of	International Review of Research in Open and Distributed Learning	Quasi-experimental, no control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
							<p>Significant increases in agreement on the importance of Facebook in learning and nursing education (p<0.001) immediately post-intervention but not maintained 3 months after evaluation, returning to pre-evaluation levels (p=0.169).</p>	<p>among disadvantaged groups, and to facilitate a responsible and reflective use of social networking sites, learners, and, in particular, the most marginalized ones, need to be especially enabled, not only regarding the use of technology, but also with respect to the risks and challenges ties to the very nature of social media.]</p>	<p>technical competency and learners started using the platform for further learning purposes. Intervention triggered appropriation and internalization of technology as part of their educational repertoire and equipped them to use social media as an instrument for further educational and professional purposes. [Leveraging freely available social networking spaces that can be conveniently accessed on learners' mobile devices may be seen as a viable way to redress educational imbalances by improving learners'</p>		

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
									access to previously untapped educational resources.]		

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
McConnell. K. A. et al. (2017)	Telehealth to expand community health nurse education in rural Guatemala: A pilot feasibility and acceptability evaluation	Using telehealth technology as teaching method for FLHWs.	Program evaluation for this telehealth curriculum aimed to prove knowledge gains in child health topics, assess satisfaction and convenience with telehealth technology, demonstrate connection between learners and instructors, and identify challenges in delivery.	Distance learning. Didactic teaching with additional time for questions, case presentations and discussions of cases and experiences in community via telehealth. Teaching documents available. Blended.	Child health topics (including anemia, ear infections, zinc, urinary tract infections, antibiotics, vaccines, obesity, vitamin A, injury prevention, and burns). Topics selected based on CHN preferences and instructor ability. Part of existing program.	Quantitative (surveys)	Mean for each lecture increased 1.4-19.9%, with an overall increase of 10.7% among all topics. Overall positive responses regarding content with 98%+ agreement with each positive statement. Overall CHNs were extremely satisfied with the lecture delivery via telehealth and direct teaching, and high satisfaction rates from instructors.	No clear tracking of costs spent or saved, and difficult to conduct cost-effectiveness analysis due to shared university resources and faculty time commitments that are difficult to quantify, making generalizability difficult and difficult to estimate scale-up costs in non-academic settings. Some lectures were delayed or postponed due to poor connectivity (rarely).	Low start-up costs and minimal resources needed to develop and implement telehealth program, using existing computer equipment, Internet connections, teleconferencing software, and office space substantially reduced initiation costs. Infrastructure support and technical expertise provided by Telehealth Department of Centre for Global Health at the Colorado School of Public Health. Lecture during scheduled lecture time and work hours for CHNs added no additional instructor salary costs. Interactive, repetitive, and	Frontiers in Public Health	Quasi-experimental, no control group (pilot)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
									case-based learning style. Instructors' participation with and knowledge of the community health program allowed the team to create content directly applicable to the situations in which CHNs worked daily.		
Rahimi, M. S., Fahami, F., & Najimi, A. (2017)	The effectiveness of training through mobile on the practice of midwives in the management of pre-eclampsia	Midwife training via smartphone on the knowledge, practice, and management of pre-eclampsia.	Aimed to determine the effect of training via smartphones on the knowledge and practice of a midwife for administration of pre-eclampsia.	Mobile learning - software on smartphone. Multiple choice questions. Ongoing training.	Guide booklet of obstetric services was used regarding pre-eclampsia and post-partum practices.	Quantitative (surveys)	Significant mean score difference for knowledge in both groups post-test ($p=0.001$), and for intervention group significant relationship between pre- and post-test ($p=0.001$). Post-intervention intervention group showed significantly better performance in management of pre-eclampsia compared to control group ($p=0.004$) and	Individual differences associated with the impact of education is an uncontrollable variable.	Repetition was possible to increase knowledge and improve practice. Information available to all, everywhere and at all times. Type of learning that is fast and dynamic, yet low-cost making raining available to everyone.	Biomedical & Pharmacology Journal	Quasi-experimental with control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
							pre-test scores (p<0.001).				

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Sranacharoeng, K. et al. (2009)	Process and outcome evaluation of a diabetes prevention education program for community healthcare workers in Thailand	Training course to facilitate learning about prevention of type 2 diabetes as well as skill development to support activities aimed at primary prevention of diabetes at community level.	1) Briefly describe the development of a culturally-tailored diabetes prevention education program for CHCWs in Thailand; 2) to document the process evaluation by CHCWs over the 4-month implementation program; and 3) to assess pre-post program changes in CHCWs' knowledge.	Training course served as a basis of health education for workers. Blended learning: mix of classroom and e-Learning approaches and activities including discussions, problem-based learning, community-based application assignments, self-evaluations and online support. e-Learning website content included lecture materials (videotaped and lectures developed on PowerPoint had added voice-over narration), quizzes, assignments, newsletters and community resources. Interactive vs. didactic training.	Key components were diabetes and lifestyle, nutrition and fitness (8 modules - complemented each other, and each could be divided into several shorter lessons, or incorporated with a different module) to facilitate learning and skill development of CHCWs about community-based prevention of type 2 diabetes. Content based on literature and research team's experiences in training health providers at the Institute of Nutrition, Mahidol University in Thailand.	Quantitative (surveys)	Learning outcomes: In intervention group significant knowledge gain in all 4 topics from baseline to after training ($p < 0.001$); significantly improved total knowledge score ($p < 0.001$) which was significantly higher than control group post-test score. Pre-intervention none reached the passing score of $>70\%$, while 77% of all CHCWs passed criterion after training. Process evaluation: In intervention group 83% liked the interactive classroom modules and self-directed e-learning; 68% learned new content, 97% could apply content on the job, 80%	Specific barriers to transferring knowledge gained through training program to at-risk populations: Heavy workload and lack of time limit health promotion activities. CHCWs needed ongoing support after training. Long-term sustainability and participation of CHCWs in health promotion depends on cooperation of district, provincial and national levels of government, and their commitments to include disease prevention within healthcare strategies.	54% of CHCWs felt computer skills were easy to learn, 70% indicated training program was not too long. This program was supported by decision-makers.	Education for Health	RCT with control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
							<p>found training materials helpful, 54% felt more confident to teach at-risk populations about diabetes prevention. CHCW satisfaction showed a high level of approval of the training.</p>				

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Chen, Y. et al. (2014)	Use of text messages to communicate clinical recommendations to health workers in rural China: a cluster-randomised trial	Text messages sent to rural health workers containing evidence-based recommendations to improve knowledge and influence prescribing medical practice.	Tested whether text messages sent to rural health workers containing evidence-based recommendations could improve knowledge and influence prescribing medical practice.	Text messages vs. traditional training. Ongoing training, mobile learning	Recommendations were mainly sourced from <i>Clinical evidence</i> and the Cochrane Library.	Quantitative (surveys)	After receiving text messages, average score in intervention group increased significantly more than in control group, both at cluster (difference=0.16, 95%CI: 0.157-0.163) and the individual level (difference=0.17, 95%CI: 0.168-0.172). One third of the health workers in the intervention group reported that they frequently adopted the recommendations in their clinical decision-making and 95% wanted to continue receiving text messages. Changed prescription practices by family physicians: less antibiotics and steroids for viral infections affecting the upper	Dissemination of highly detailed information is limited by number of characters available for text message (280 here). Only short-term effects were measured. Ambiguity of causal relationship between text messages and physicians' behaviour change. Despite increased scores post-intervention, average scores remained poor suggesting text messaging may be an improvement over traditional educational methods but its role in continuing medical education needs further research. The complexities of behaviour change might not have been fully captured (based on prescriptions	Text messages were the only way to obtain the latest and best clinical knowledge by the majority of health workers. Text messages were easier to carry, retrieve and remember compared to textbooks and printed learning materials. Text messages are the preferred method of communicating medical information versus television, radio, newspapers, or blackboards in health centres. Text messages are tailored to the local disease context and edited on the basis of feedback to suit clinical needs. Cost-effectiveness.	Bulletin of the World Health Organization	RCT with control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
							respiratory tract.	that could reflect behaviour).			

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Mastellos, N. et al. (2018)	Training community healthcare workers on the use of information and communication technologies: a randomised controlled trial of traditional versus blended learning in Malawi, Africa	Integrating distance mLearning as part of a blended learning program in equipping HSAs with knowledge and skills to use computers, tablets and smartphones in their everyday practice, as well as to advance understanding of potential e/mHealth in health care provision and public health policy.	1) To develop and test a questionnaire assessing HSAs' knowledge and attitudes towards computers, tablets and smartphones (phase 1). 2) To assess the effectiveness of the traditional and blended learning courses i.t.o. improving HSAs' knowledge and attitudes towards computers, tablets and smartphones (phase 2). 3) To assess participants' experience and satisfaction with the course (phase 2)	Blended (vs. traditional) learning courses. Ongoing - new content.	Based on Bloom's taxonomy to equip HSAs and supervisors with adequate knowledge and skills to use ICT solutions in everyday practice, and advance understanding of the potential of eHealth and mHealth in healthcare provision and public health policy.	Quantitative (surveys)	Significant increase in post-intervention score for self-rated ICT knowledge and higher post-intervention scores for actual ICT knowledge in both groups. Positive attitudinal gains after attending the course in both groups, with significant attitudinal gains in 5 domains in intervention group and 2 in control group. Generally high satisfaction scores in both groups, but intervention group found it more difficult to follow course content and control group enjoyed the course more than the intervention group.	After course completion, ICT competence was still elementary. Unfamiliarity with basic computer hardware (keyboard and mouse) which needed more practical tie on the use of computers. Use of self-rated scales without some objective measure in similar contexts is problematic. Length of the course was short and they needed more time in the computer lab to master practical components of the course. Problems with course content specifically in blended group due to independent learning sessions reinforcing need for more ICT skills training in the lab. Lack of infrastructure of ICT impedes implementation of eLearning initiatives.	All HSAs had experience with mobile phones. Blended learning courses have the potential to meet training needs of CHWs with less disruption compared to traditional learning. More cost-effective.	BMC Medical Education	RCT with control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
								<p>smartphones rather than laptops are therefore provided due to limitations and infrastructural challenges within villages. Absence of computer at home made it difficult to grasp some concepts. Limited electricity supply presents a barrier to implementation and sustainability of electronically mediated programmes in Malawi. Limited support during off-site sessions due to lack of Internet connectivity.</p>			

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
O'Donovan, J. et al. (2018)	The use of low-cost Android tablets to train community health workers in Mukono, Uganda, in the recognition, treatment and prevention of pneumonia in children under five: a pilot randomised controlled trial	Using tablet-based training for knowledge acquisition regarding the cause, prevention and management of pneumonia amongst CHWs.	Describes the use of a low-cost Android tablets pre-loaded with locally made educational videos to train CHWs in rural Uganda in the recognition, treatment and prevention of pneumonia in accordance with iCCM guidelines. Hypothesis: That tablet-based training would be feasible, acceptable and comparable to traditional training i.t.o. knowledge acquisition regarding the cause, prevention and management of pneumonia amongst CHWs.	Refresher training on the pneumonia component of initial iCCM training 2 years prior. Mobile learning. Didactic.	Up to date iCCM guidelines focusing on pneumonia. Approved by the Commissioner for Child Health at MoH and 2 independent medical doctors for accuracy.	Quantitative (surveys)	Improvement in MCQ score for both groups between pre- and post-intervention testing, but not significant (p=0.254). For both groups CHWs with the lowest pre-training scores improved the most (p<0.001). Most of intervention group reported a positive experience using a tablet as training tool. No significant difference between intervention and control groups in terms of improvement in assessment scores on both the theoretical and clinical case testing, it was found that providing refresher training via low-cost Android tablets to CHWs in rural Uganda was	Despite digital literacy course, CHWs had difficulty using tablets and did not know how to work them. Most prominent problems were battery life and inability to pause videos. Variation in CHW programmes as multiple different NGOs take responsibility for provision of CHW training - government of Uganda is addressing this by implementing a centralised model of CHW training to try and control for quality assurance. 5 days too short for training according to CHWs.	Tablet-based training requires fewer supervisors to deliver training, less time consuming, ensure training material is delivered consistently and up-to-date ensuring quality and can be checked for accuracy. Positive feedback about flexibility of tablet-based training. Working with CHWs from an early stage ensured delivery of culturally appropriate training material. Local language featuring a local physician contributes to sense of ownership and understanding. Tablet allowed for repeated	Human Resources for Health	RCT with control group (pilot)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
							feasible and well received.		review of concepts, allowing own pace of learning and enables CHWs with less classroom experience (fewer years of formal education) to keep up. Videos allowed for better focus on concepts that are difficult to teach didactically or text-based. Solar charged tablets were not susceptible to power outages. CHWs helped each other with technical issues.		

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Woods, D. et al. (2012)	Text messages as a learning tool for midwives	Text messages as a method of education to midwives in the public and private sectors.	Aimed to assess whether this method of education is acceptable to midwives in SA public and private sectors.	Continuing education through ongoing training. Distance, interactive.	Essential learning messages selected from the <i>Maternal Care</i> course book of the Perinatal Education Programme (PEP). Each message ended with a link to the Sister Lillian website, which in turn linked to the publisher's website, where the corresponding <i>Maternal Care</i> chapter could be read.	Quantitative (surveys)	86% enjoyed and learned from messages; 72% believed the messages improved their clinical practice; 100% wanted to receive further messages on other important topics.	Lack of access to the Internet and failure to use this facility to obtain additional information.	Text messages via personal cell phones were well received, information was widely shared with colleagues and believed to improve learning and patient care. Cost-effective learning opportunities and improve a wide range of clinical services.	South African Medical Journal	Cross-sectional, no control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Chipps, J. et al. (2015)	Using mobile phones and social media to facilitate education and support for rural-based midwives in South Africa	Using mobile technology, ICTs and social networks to enhance the learning environment.	To establish existing usage patterns and perceptions of ICT and, in particular, of mobile phones and social media and networks, e.g. Facebook to gain a better understanding for the purpose of incorporating these technologies into existing educational programmes. Also effectiveness.	Blended learning programme including weekly in-person videoconferencing lectures and appointment of local facilitators to support midwives at rural sites. Some programme material was placed online (via open source learning management system) and most material and resources were photocopied and posted to rural sites.	Not reported	Quantitative (surveys)	78.6% of respondents rated mobile phones as important for discussing learning and accessing information. 55.4% were positive about using social networking sites to assist in education but only 23.2% reported using Facebook for obtaining medical information. Most rated a laptop as the most effective ICT for education and learning, followed by learning management systems and smartphones.	Low personal computer ownership and slow bandwidth at rural hospitals. Respondents were older learners, with more than half reporting low levels of computer competency and difficulty using new technology. Use of technologies for educational purposes remained out of date at universities and workplaces. Low usage of smartphone functions. 50% response rate which could have influenced findings. Uncertainty of respondents' understanding of differences between mobile phones with smartphone capacities and traditional mobile phones. Limited perceived technical competency and restricted	All except 2 respondents owned a mobile phone and half reported owning smartphones that they use to access the Internet. Respondents felt relatively competent in using their mobile phones, though less so with new technologies (e.g. Facebook). Generally positive attitude towards technology and investments in technology by universities and workplaces. Higher use of mobile phones compared to other ICT for educational and work-related activities - mostly by calls and SMS/text. Relatively high usage	Curatoris	Cross-sectional, no control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
								institutional support.	patterns of mobile phones and high expectations with regard to their value for learning and work purposes.		
Asgary, R. et al. (2016)	mHealth to train community health nurses in Visual Inspection with Acetic Acid for cervical cancer screening in Ghana	Smartphone / text messaging supported training of CHNs in performing cervical cancer screening using VIA.	To evaluate feasibility and limited efficacy of a smartphone/text messaging supported training of CHNs in performing cervical cancer screening using VIA.	Blended learning, mHealth supported training. In-person onsite course that follows a detailed training manual in a classroom setting with audio-visual course material. mHealth training phase - offered VIA screening, captured	Didactic and clinically mentored instruction in VIA and using mannequins to teach mechanics of a speculum, 20-30 actual clinical and practical cases, and training in digital photography with smartphone. Trained in cancer health education and post VIA	Quantitative (observation)	Agreement rate with the expert reviewer of up to 89.6% and a substantial kappa statistic of 0.67 for VIA diagnoses made by each CHN over 3 months of mHealth supported training. Very high agreement rate for negative cases which implies a	Logistic challenges: securing necessary supplies, transferring grant funds to acquire identical smartphones and some additional administrative hurdles to what was expected. All administrative challenges eventually addressed by negotiating with different	Protocol was established within the well-structured and supervised community nurse program, which is linked to the national health program, and through long-term existing working relationship, members of the research	Journal of Lower Genital Tract Disease	Cross-sectional, no control group (pilot)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
				cervical images using smartphones, recorded their diagnosis and plan of care, sent images and diagnoses and plan of care real-time electronically to expert reviewer and received feedback. Part of existing CHNs program in collaboration with Ghana's Health Services and part of the national health care system in Ghana.	management decisions.		decrease in number of referrals for treatment and/or further evaluation, decreasing unnecessary burden on the health system.	stakeholders and provision of necessary basic supplies at community health centres. Delays in initial screening due to holiday season and lag of awareness raising in communities. Lo quality images addressed by providing additional one-on-one training.	team were well known by CHNs and their supervisors prior to implementation of study. Fear of cancer diagnosis was a barrier for seeking screening overcome by providing additional training sessions focusing on skills in communicating the importance of screening and addressing negative perceptions and fears among patients, which led to a sharp increase in number of women seeking screening.		

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Yeates, K. E. et al. (2016)	Evaluation of a smartphone-based training strategy among health care workers screening for cervical cancer in Northern Tanzania: The Kilimanjaro Method	Smartphone-based cervicography and text message (image transfer) to enhance VIA training, quality, and accuracy through real-time mentorship and training of health workers; described as smartphone-enhanced VIA (SEVIA).	To evaluate the effectiveness of a smartphone-based cervicography and text message (image transfer) platform to enhance VIA training, quality and accuracy through real-time mentorship and training of health care workers providing CCS in semirural Tanzania.	In-service, continuing education, enhancing usual day-to-day work activities. Blended (6-day didactic then practical)	Cervical cancer prevention expert and 2 digital cervicography experts developed and implemented training program and provided mentorship. MOHSW competency-based program and VIA training of SEVIA protocol.	Quantitative (observation)	Overall 96.8% agreement between participants and expert reviewers; initial disagreement of $\pm 10\%$ reduced to $< 3\%$ after first month and remained close to that level for most of the remainder of the study.	Challenge of providing effective quality assurance through maintenance of CCS provider skills and efficient and cost-effective methods to train and retain providers.	SEVIA has the ability to provide additional visual enhancement if VIA, and combined with mobile connectivity, provides and excellent platform to strengthen and maintain VIA skills and expertise when combined with a well-structured and pragmatic mentorship program. Feasible training method which facilitated rapid development of skills. Minimal requirement for equipment and infrastructure in any setting which allowed screening teams to become mobile and reach at risk women in rural areas where screening had	Journal of Global Oncology	Cross-sectional, no control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
									been unavailable. Patient-provider relationship empowered women to learn and seek information regarding their health. Strengthen goal of task shifting.		
Bellina, L. et al. (2014)	M-phone impact on practical training: role of m-phone as part of the educative method for training local health workers of rural areas of developing countries	Using structured interviews, didactic tables, mobile phones and computers as didactic tools for training in basic laboratory skills, diagnostic microscopy and using mobile phone to capture microscope snapshot images.	To evaluate the psychological impact of the m-phone use in the learning mechanisms, in limited-resource settings and to explore the psychological mechanisms behind this method.	Two-phase approach training (phase of relation and phase of contextualization including use of didactic tables and use of m-phone as didactic tool). Ongoing training. Interactive.	Trained in microscopic techniques such as: microscope use, sample collection and preparation, and appropriate disposal of biologic and other materials, in basic preparation and observation of slides of various bodily fluids (fresh and standard stain preparations as well as using a mobile phone to capture microscopic images.	Qualitative (interviews)	All participants affirmed that the course was different and more liked than traditional courses previously attended, course was much easier and comprehensible, course took into account the community, lessons enhanced competence and relationships with the communities. All participants enjoyed learning by this method more than with traditional courses. Combination	None reported	Approach has been applied to illiterate subjects and all learned without difficulties. Use of mobile phones to share images is greatly appreciated by students, mostly for global-local value of this globally widespread device. No power relation is involved in this education process (relationship between teacher and student turns into a mechanism of transmission of "love-objects", and	Health and Technology	Qualitative, no control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
							of all didactic components, the course was said to be crucial for the enhancement of participants' position in the community as it was new appreciated, easy, practical, and focused on students' independence.		is built reciprocal understanding and sharing of needs without any barrier or border related to the cultural context). Education is contextualised. Mobile phone generates an infinite transmission of data, thus creating a never-ending increase of knowledge.		

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
Pimmer, C. & Mbvundula, F. (2018)	One message, many voices: Mobile audio counselling in health education	Using mobile phone-based audio messages for counselling on preventative and curative health issues related to the accomplishment of the MDGs.	To understand the user's perception of the meaning of audio-messages when used in health counselling in the specific social and cultural contexts in which these technologies have been introduced.	Interactive information transmission, constructivist learning. Ongoing - new content.	Informative messages regarding preventive and curative health issues related to the accomplishment of the MDGs within the Millennium Villages Project.	Qualitative (interpretive case study)	Audio used for counselling was seen as an educational tool and CHWs reported it as a relevant source for their learning as messages constantly helped them to recall and internalised basic messages which is regarded as a viable means of learning.	CHWs need specific training before they start linking the audio to their own counselling practices.	Unexpected dynamics like constructivist learning through discussions between health workers and community members. Informative and participatory nature of audio-counselling was perceived to have a legitimising function and to address a number of informational and attendant sociocultural and political barriers. Scaffolded delivery of counseling information through mutually constitutive and interwoven process between CHW who added situation specific and contextualised information and the virtual	Journal of Health Care for the Poor and Underserved	Qualitative, no control group (not reported)

Author (year)	Title	Intervention / program	Objectives	Type of training	Content	Evaluation method /outcome measure	Findings	Challenges	Facilitating factors	Journal	Study design (stage)
									<p>expert who ensured the complete delivery of the standardised message. Assertive persuasion - proximity established through using the same language and through repetition of the CHWs' messages; authority through experts from "above". Relatively easy and cheap to create, and as a relevant role in health service delivery.</p>		

Appendix E: Joanna Briggs Institute (JBI) Appraisal Tools

1. JBI Checklist for Randomized Controlled Trials

JBI Critical Appraisal Checklist for Randomised Controlled Trials

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	NA
1. Was true randomization used for assignment of participants to treatment groups?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Was allocation to treatment groups concealed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Were treatment groups similar at the baseline?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were participants blind to treatment assignment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were those delivering treatment blind to treatment assignment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were outcomes assessors blind to treatment assignment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were treatment groups treated identically other than the intervention of interest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Were participants analyzed in the groups to which they were randomised?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Were outcomes measured in the same way for treatment groups?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Were outcomes measured in a reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

Explanation for the critical appraisal tool for RCTs with individual participants in parallel groups

How to cite: Tufanaru C, Munn Z, Aromataris E, Campbell J, Hopp L. Chapter 3: Systematic reviews of effectiveness. In: Aromataris E, Munn Z (Editors). *Joanna Briggs Institute Reviewer's Manual*. The Joanna Briggs Institute, 2017. Available from <https://reviewersmanual.joannabriggs.org/>

Critical Appraisal Tool for RCTs (individual participants in parallel groups)

Answers: Yes, No, Unclear or Not Applicable

1. Was true randomization used for assignment of participants to treatment groups?

The differences between participants included in compared groups constitutes a threat to the internal validity of a study exploring causal relationships. If participants are not allocated to treatment and control groups by random assignment there is a risk that the allocation is influenced by the known characteristics of the participants and these differences between the groups may distort the comparability of the groups. A true random assignment of participants to the groups means that a procedure is used that allocates the participants to groups purely based on chance, not influenced by the known characteristics of the participants. Check the details about the randomization procedure used for allocation of the participants to study groups. Was a true chance (random) procedure used? For example, was a list of random numbers used? Was a computer-generated list of random numbers used?

2. Was allocation to groups concealed?

If those allocating participants to the compared groups are aware of which group is next in the allocation process, that is, treatment or control, there is a risk that they may deliberately and purposefully intervene in the allocation of patients by preferentially allocating patients to the treatment group or to the control group and therefore this may distort the implementation of allocation process indicated by the randomization and therefore the results of the study may be distorted. Concealment of allocation (allocation concealment) refers to procedures that prevent those allocating patients from knowing before allocation which treatment or control is next in the allocation process. Check the details about the procedure used for allocation concealment. Was an appropriate allocation concealment procedure used? For example, was central randomization used? Were sequentially numbered, opaque and sealed envelopes used? Were coded drug packs used?

3. Were treatment groups similar at the baseline?

The differences between participants included in compared groups constitute a threat to the internal validity of a study exploring causal relationships. If there are differences between participants included in compared groups there is a risk of selection bias. If there are differences between participants included in the compared groups maybe the 'effect' cannot be attributed to the potential 'cause' (the examined intervention or treatment), as maybe it is plausible that the 'effect' may be explained by the differences between participants, that is, by selection bias. Check the characteristics reported for participants. Are the participants from the compared groups similar with regards to the characteristics that may explain the effect even in the absence of the 'cause', for example, age, severity of the disease, stage of the disease, co-existing conditions and so on? Check the proportions of participants with specific relevant characteristics in the compared groups. Check the means of relevant measurements in the compared groups (pain scores; anxiety scores; etc.). *[Note: Do NOT only consider the P-value for the statistical testing of the differences between groups with regards to the baseline characteristics.]*

4. Were participants blind to treatment assignment?

If participants are aware of their allocation to the treatment group or to the control group there is the risk that they may behave differently and respond or react differently to the intervention of interest or to the control intervention respectively compared to the situations when they are not aware of treatment allocation and therefore the results of the study may be distorted. Blinding of participants is used in order to minimize this risk. Blinding of the participants refers to procedures that prevent participants from knowing which group they are allocated. If blinding of participants is used, participants are not aware if they are in the group receiving the treatment of interest or if they are in any other group receiving the control interventions. Check the details reported in the article about the blinding of participants with regards to treatment assignment. Was an appropriate blinding procedure used? For

example, were identical capsules or syringes used? Were identical devices used? Be aware of different terms used, blinding is sometimes also called masking.

5. Were those delivering treatment blind to treatment assignment?

If those delivering treatment are aware of participants' allocation to the treatment group or to the control group there is the risk that they may behave differently with the participants from the treatment group and the participants from the control group, or that they may treat them differently, compared to the situations when they are not aware of treatment allocation and this may influence the implementation of the compared treatments and the results of the study may be distorted. Blinding of those delivering treatment is used in order to minimize this risk. Blinding of those delivering treatment refers to procedures that prevent those delivering treatment from knowing which group they are treating, that is those delivering treatment are not aware if they are treating the group receiving the treatment of interest or if they are treating any other group receiving the control interventions. Check the details reported in the article about the blinding of those delivering treatment with regards to treatment assignment. Is there any information in the article about those delivering the treatment? Were those delivering the treatment unaware of the assignments of participants to the compared groups?

6. Were outcomes assessors blind to treatment assignment?

If those assessing the outcomes are aware of participants' allocation to the treatment group or to the control group there is the risk that they may behave differently with the participants from the treatment group and the participants from the control group compared to the situations when they are not aware of treatment allocation and therefore there is the risk that the measurement of the outcomes may be distorted and the results of the study may be distorted. Blinding of outcomes assessors is used in order to minimize this risk. Check the details reported in the article about the blinding of outcomes assessors with regards to treatment assignment. Is there any information in the article about outcomes assessors? Were those assessing the treatment's effects on outcomes unaware of the assignments of participants to the compared groups?

7. Were treatment groups treated identically other than the intervention of interest?

In order to attribute the 'effect' to the 'cause' (the treatment or intervention of interest), assuming that there is no selection bias, there should be no other difference between the groups in terms of treatment or care received, other than the manipulated 'cause' (the treatment or intervention controlled by the researchers). If there are other exposures or treatments occurring at the same time with the 'cause' (the treatment or intervention of interest), other than the 'cause', then potentially the 'effect' cannot be attributed to the examined 'cause' (the investigated treatment), as it is plausible that the 'effect' may be explained by other exposures or treatments occurring at the same time with the 'cause' (the treatment of interest). Check the reported exposures or interventions received by the compared groups. Are there other exposures or treatments occurring at the same time with the 'cause'? Is it plausible that the 'effect' may be explained by other exposures or treatments occurring at the same time with the 'cause'? Is it clear that there is no other difference between the groups in terms of treatment or care received, other than the treatment or intervention of interest?

8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?

For this question, follow up refers to the time period from the moment of random allocation (random assignment or randomization) to compared groups to the end time of the trial. This critical appraisal question asks if there is complete knowledge (measurements, observations etc.) for the entire duration of the trial as previously defined (that is, from the moment of random allocation to the end time of the trial), for all randomly allocated participants. If there is incomplete follow up, that is incomplete knowledge about all randomly allocated participants, this is known in the methodological literature as the post-assignment attrition. As RCTs are not perfect, there is almost always post-assignment attrition, and the focus of this question is on the appropriate exploration of post-assignment attrition (description of loss to follow up, description of the reasons for loss to follow up, the estimation of the impact of loss to follow up on the effects etc.). If there are differences with regards to the loss to follow up between the compared groups in an RCT, these differences represent a threat to the internal validity of a randomised experimental study exploring causal effects, as these differences may provide a plausible alternative explanation for the observed 'effect' even in the absence of the 'cause' (the treatment or intervention of interest). When appraising an RCT, check if there were differences with regards to the loss to follow up between the compared groups. If follow up was incomplete (that is,

there is incomplete information on all participants), examine the reported details about the strategies used in order to address incomplete follow up, such as descriptions of loss to follow up (absolute numbers; proportions; reasons for loss to follow up) and impact analyses (the analyses of the impact of loss to follow up on results). Was there a description of the incomplete follow up (number of participants and the specific reasons for loss to follow up)? It is important to note that with regards to loss to follow up, it is not enough to know the number of participants and the proportions of participants with incomplete data; the reasons for loss to follow up are essential in the analysis of risk of bias; even if the numbers and proportions of participants with incomplete data are similar or identical in compared groups, if the patterns of reasons for loss to follow up are different (for example, side effects caused by the intervention of interest, lost contact etc.), these may impose a risk of bias if not appropriately explored and considered in the analysis. If there are differences between groups with regards to the loss to follow up (numbers/proportions and reasons), was there an analysis of patterns of loss to follow up? If there are differences between the groups with regards to the loss to follow up, was there an analysis of the impact of the loss to follow up on the results? [Note: Question 8 is NOT about intention-to-treat (ITT) analysis; question 9 is about ITT analysis.]

9. Were participants analyzed in the groups to which they were randomised?

This question is about the intention-to-treat (ITT) analysis. There are different statistical analysis strategies available for the analysis of data from randomised controlled trials, such as intention-to-treat analysis (known also as intent to treat; abbreviated, ITT), per-protocol analysis, and as-treated analysis. In the ITT analysis the participants are analyzed in the groups to which they were randomised, regardless of whether they actually participated or not in those groups for the entire duration of the trial, received the experimental intervention or control intervention as planned or whether they were compliant or not with the planned experimental intervention or control intervention. The ITT analysis compares the outcomes for participants from the initial groups created by the initial random allocation of participants to those groups. Check if ITT was reported; check the details of the ITT. Were participants analyzed in the groups to which they were initially randomised, regardless of whether they actually participated in those groups, and regardless of whether they actually received the planned interventions? [Note: The ITT analysis is a type of statistical analysis recommended in the Consolidated Standards of Reporting Trials (CONSORT) statement on best practices in trials reporting, and it is considered a marker of good methodological quality of the analysis of results of a randomised trial. The ITT is estimating the effect of offering the intervention, that is, the effect of instructing the participants to use or take the intervention; the ITT it is not estimating the effect of actually receiving the intervention of interest.]

10. Were outcomes measured in the same way for treatment groups?

If the outcome (the 'effect') is not measured in the same way in the compared groups there is a threat to the internal validity of a study exploring a causal relationship as the differences in outcome measurements may be confused with an effect of the treatment (the 'cause'). Check if the outcomes were measured in the same way. Same instrument or scale used? Same measurement timing? Same measurement procedures and instructions?

11. Were outcomes measured in a reliable way?

Unreliability of outcome measurements is one threat that weakens the validity of inferences about the statistical relationship between the 'cause' and the 'effect' estimated in a study exploring causal effects. Unreliability of outcome measurements is one of the different plausible explanations for errors of statistical inference with regards to the existence and the magnitude of the effect determined by the treatment ('cause'). Check the details about the reliability of measurement such as the number of raters, training of raters, the intra-rater reliability, and the inter-raters reliability within the study (not as reported in external sources). This question is about the reliability of the measurement performed in the study, it is not about the validity of the measurement instruments/scales used in the study. [Note: Two other important threats that weaken the validity of inferences about the statistical relationship between the 'cause' and the 'effect' are low statistical power and the violation of the assumptions of statistical tests. These other two threats are explored within Question 12).]

12. Was appropriate statistical analysis used?

Inappropriate statistical analysis may cause errors of statistical inference with regards to the existence and the magnitude of the effect determined by the treatment ('cause'). Low statistical power and the violation of the assumptions of statistical tests are two important threats that weaken the validity of inferences about the statistical relationship between the 'cause' and the 'effect'. Check the following aspects: if the assumptions of statistical tests were respected; if appropriate statistical power analysis was performed; if appropriate effect sizes were used; if appropriate statistical procedures or methods were used given the number and type of dependent and independent variables, the number of study groups, the nature of the relationship between the groups (independent or dependent groups), and the objectives of statistical analysis (association between variables; prediction; survival analysis etc.).

13. Was the trial design appropriate for the topic, and any deviations from the standard RCT design accounted for in the conduct and analysis?

Certain RCT designs, such as the crossover RCT, should only be conducted when appropriate. Alternative designs may also present additional risks of bias if not accounted for in the design and analysis.

Crossover trials should only be conducted in people with a chronic, stable condition, where the intervention produces a short term effect (i.e. relief in symptoms). Crossover trials should ensure there is an appropriate period of washout between treatments.

Cluster RCTs randomize groups of individuals, forming 'clusters.' When we are assessing outcomes on an individual level in cluster trials, there are unit-of-analysis issues, as individuals within a cluster are correlated. This should be taken into account by the study authors when conducting analysis, and ideally authors will report the intra-cluster correlation coefficient.

Stepped-wedge RCTs may be appropriate when it is expected the intervention will do more good than harm, or due to logistical, practical or financial considerations in the roll out of a new treatment/intervention. Data analysis in these trials should be conducted appropriately, taking into account the effects of time.

2. JBI Checklist for Quasi-Experimental Studies

JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomised experimental studies)

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the participants included in any comparisons similar?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was there a control group?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes of participants included in any comparisons measured in the same way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Were outcomes measured in a reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

Explanation for the critical appraisal tool for Quasi-Experimental Studies (experimental studies without random allocation)

How to cite: Tufanaru C, Munn Z, Aromataris E, Campbell J, Hopp L. Chapter 3: Systematic reviews of effectiveness. In: Aromataris E, Munn Z (Editors). *Joanna Briggs Institute Reviewer's Manual*. The Joanna Briggs Institute, 2017. Available from <https://reviewersmanual.joannabriggs.org/>

Critical Appraisal Tool for Quasi-Experimental Studies (experimental studies without random allocation)

Answers: Yes, No, Unclear or Not Applicable

1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?

Ambiguity with regards to the temporal relationship of variables constitutes a threat to the internal validity of a study exploring causal relationships. The 'cause' (the independent variable, that is, the treatment or intervention of interest) should occur in time before the explored 'effect' (the dependent variable, which is the effect or outcome of interest). Check if it is clear which variable is manipulated as a potential cause. Check if it is clear which variable is measured as the effect of the potential cause. Is it clear that the 'cause' was manipulated before the occurrence of the 'effect'?

2. Were the participants included in any comparisons similar?

The differences between participants included in compared groups constitute a threat to the internal validity of a study exploring causal relationships. If there are differences between participants included in compared groups there is a risk of selection bias. If there are differences between participants included in the compared groups maybe the 'effect' cannot be attributed to the potential 'cause', as maybe it is plausible that the 'effect' may be explained by the differences between participants, that is, by selection bias. Check the characteristics reported for participants. Are the participants from the compared groups similar with regards to the characteristics that may explain the effect even in the absence of the 'cause', for example, age, severity of the disease, stage of the disease, co-existing conditions and so on? [NOTE: In one single group pre-test/post-test studies where the patients are the same (the same one group) in any pre-post comparisons, the answer to this question should be 'yes.']

3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?

In order to attribute the 'effect' to the 'cause' (the exposure or intervention of interest), assuming that there is no selection bias, there should be no other difference between the groups in terms of treatments or care received, other than the manipulated 'cause' (the intervention of interest). If there are other exposures or treatments occurring in the same time with the 'cause', other than the intervention of interest, then potentially the 'effect' cannot be attributed to the intervention of interest, as it is plausible that the 'effect' may be explained by other exposures or treatments, other than the intervention of interest, occurring in the same time with the intervention of interest. Check the reported exposures or interventions received by the compared groups. Are there other exposures or treatments occurring in the same time with the intervention of interest? Is it plausible that the 'effect' may be explained by other exposures or treatments occurring in the same time with the intervention of interest?

4. Was there a control group?

Control groups offer the conditions to explore what would have happened with groups exposed to other different treatments, other than to the potential 'cause' (the intervention of interest). The comparison of the treated group (the group exposed to the examined 'cause', that is, the group receiving the intervention of interest) with such other groups strengthens the examination of the causal plausibility. The validity of causal inferences is strengthened in studies with at least one independent control group compared to studies without an independent control group. Check if there are independent, separate

groups, used as control groups in the study. *[Note: The control group should be an independent, separate control group, not the pre-test group in a single group pre-test post-test design.]*

5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?

In order to show that there is a change in the outcome (the 'effect') as a result of the intervention/treatment (the 'cause') it is necessary to compare the results of measurement before and after the intervention/treatment. If there is no measurement before the treatment and only measurement after the treatment is available it is not known if there is a change after the treatment compared to before the treatment. If multiple measurements are collected before the intervention/treatment is implemented then it is possible to explore the plausibility of alternative explanations other than the proposed 'cause' (the intervention of interest) for the observed 'effect', such as the naturally occurring changes in the absence of the 'cause', and changes of high (or low) scores towards less extreme values even in the absence of the 'cause' (sometimes called regression to the mean). If multiple measurements are collected after the intervention/treatment is implemented it is possible to explore the changes of the 'effect' in time in each group and to compare these changes across the groups. Check if measurements were collected before the intervention of interest was implemented. Were there multiple pre-test measurements? Check if measurements were collected after the intervention of interest was implemented. Were there multiple post-test measurements?

6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?

If there are differences with regards to the loss to follow up between the compared groups these differences represent a threat to the internal validity of a study exploring causal effects as these differences may provide a plausible alternative explanation for the observed 'effect' even in the absence of the 'cause' (the treatment or exposure of interest). Check if there were differences with regards to the loss to follow up between the compared groups. If follow up was incomplete (that is, there is incomplete information on all participants), examine the reported details about the strategies used in order to address incomplete follow up, such as descriptions of loss to follow up (absolute numbers; proportions; reasons for loss to follow up; patterns of loss to follow up) and impact analyses (the analyses of the impact of loss to follow up on results). Was there a description of the incomplete follow up (number of participants and the specific reasons for loss to follow up)? If there are differences between groups with regards to the loss to follow up, was there an analysis of patterns of loss to follow up? If there are differences between the groups with regards to the loss to follow up, was there an analysis of the impact of the loss to follow up on the results?

7. Were the outcomes of participants included in any comparisons measured in the same way?

If the outcome (the 'effect') is not measured in the same way in the compared groups there is a threat to the internal validity of a study exploring a causal relationship as the differences in outcome measurements may be confused with an effect of the treatment or intervention of interest (the 'cause'). Check if the outcomes were measured in the same way. Same instrument or scale used? Same measurement timing? Same measurement procedures and instructions?

8. Were outcomes measured in a reliable way?

Unreliability of outcome measurements is one threat that weakens the validity of inferences about the statistical relationship between the 'cause' and the 'effect' estimated in a study exploring causal effects. Unreliability of outcome measurements is one of different plausible explanations for errors of statistical inference with regards to the existence and the magnitude of the effect determined by the treatment ('cause'). Check the details about the reliability of measurement such as the number of raters, training of raters, the intra-rater reliability, and the inter-raters reliability within the study (not to external sources). This question is about the reliability of the measurement performed in the study, it is not about the validity of the measurement instruments/scales used in the study. *[Note: Two other important threats that weaken the validity of inferences about the statistical relationship between the 'cause' and the 'effect' are low statistical power and the violation of the assumptions of statistical tests. These other threats are not explored within Question 8, these are explored within Question 9.]*

9. Was appropriate statistical analysis used?

Inappropriate statistical analysis may cause errors of statistical inference with regards to the existence and the magnitude of the effect determined by the treatment ('cause'). Low statistical power and the

violation of the assumptions of statistical tests are two important threats that weakens the validity of inferences about the statistical relationship between the 'cause' and the 'effect'. Check the following aspects: if the assumptions of statistical tests were respected; if appropriate statistical power analysis was performed; if appropriate effect sizes were used; if appropriate statistical procedures or methods were used given the number and type of dependent and independent variables, the number of study groups, the nature of the relationship between the groups (independent or dependent groups), and the objectives of statistical analysis (association between variables; prediction; survival analysis etc.).

3. JBI Checklist for Qualitative Research

JBI Critical Appraisal Checklist for Qualitative Research

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not applicable
1. Is there congruity between the stated philosophical perspective and the research methodology?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Is there congruity between the research methodology and the research question or objectives?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Is there congruity between the research methodology and the methods used to collect data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Is there congruity between the research methodology and the representation and analysis of data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Is there congruity between the research methodology and the interpretation of results?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Is there a statement locating the researcher culturally or theoretically?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Is the influence of the researcher on the research, and vice-versa, addressed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Are participants, and their voices, adequately represented?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

Discussion of Critical Appraisal Criteria for Qualitative Research

How to cite: Lockwood C, Munn Z, Porritt K. Qualitative research synthesis: methodological guidance for systematic reviewers utilizing meta-aggregation. *Int J Evid Based Healthc.* 2015;13(3):179–187.

1. **Congruity between the stated philosophical perspective and the research methodology**

Does the report clearly state the philosophical or theoretical premises on which the study is based? Does the report clearly state the methodological approach adopted on which the study is based? Is there congruence between the two? For example:

A report may state that the study adopted a critical perspective and participatory action research methodology was followed. Here there is congruence between a critical view (focusing on knowledge arising out of critique, action and reflection) and action research (an approach that focuses on firstly working with groups to reflect on issues or practices, then considering how they could be different; then acting to create a change; and finally identifying new knowledge arising out of the action taken). However, a report may state that the study adopted an interpretive perspective and used survey methodology. Here there is incongruence between an interpretive view (focusing on knowledge arising out of studying what phenomena mean to individuals or groups) and surveys (an approach that focuses on asking standard questions to a defined study population); a report may state that the study was qualitative or used qualitative methodology (such statements do not demonstrate rigour in design) or make no statement on philosophical orientation or methodology.

2. **Congruity between the research methodology and the research question or objectives**

Is the study methodology appropriate for addressing the research question? For example: A report may state that the research question was to seek understandings of the meaning of pain in a group of people with rheumatoid arthritis and that a phenomenological approach was taken. Here, there is congruity between this question and the methodology. A report may state that the research question was to establish the effects of counselling on the severity of pain experience and that an ethnographic approach was pursued. A question that tries to establish cause-and effect cannot be addressed by using an ethnographic approach (as ethnography sets out to develop understandings of cultural practices) and thus, this would be incongruent.

3. **Congruity between the research methodology and the methods used to collect data**

Are the data collection methods appropriate to the methodology? For example:

A report may state that the study pursued a phenomenological approach and data was collected through phenomenological interviews. There is congruence between the methodology and data collection; a report may state that the study pursued a phenomenological approach and data was collected through a postal questionnaire. There is incongruence between the methodology and data collection here as phenomenology seeks to elicit rich descriptions of the experience of a phenomena that cannot be achieved through seeking written responses to standardized questions.

4. **Congruity between the research methodology and the representation and analysis of data**

Are the data analyzed and represented in ways that are congruent with the stated methodological position? For example:

A report may state that the study pursued a phenomenological approach to explore people's experience of grief by asking participants to describe their experiences of grief. If the text generated from asking these questions is searched to establish the meaning of grief to participants, and the meanings of all participants are included in the report findings, then this represents congruity; the same report may, however, focus only on those meanings that were common to all participants and discard single reported meanings. This would not be appropriate in phenomenological work.

5. **There is congruence between the research methodology and the interpretation of results**

Are the results interpreted in ways that are appropriate to the methodology? For example:

A report may state that the study pursued a phenomenological approach to explore people's experience of facial disfigurement and the results are used to inform practitioners about accommodating individual differences in care. There is congruence between the methodology and this approach to interpretation; a report may state that the study pursued a phenomenological approach to

explore people's experience of facial disfigurement and the results are used to generate practice checklists for assessment. There is incongruence between the methodology and this approach to interpretation as phenomenology seeks to understand the meaning of a phenomenon for the study participants and cannot be interpreted to suggest that this can be generalized to total populations to a degree where standardized assessments will have relevance across a population.

6. Locating the researcher culturally or theoretically

Are the beliefs and values, and their potential influence on the study declared? For example:

The researcher plays a substantial role in the qualitative research process and it is important, in appraising evidence that is generated in this way, to know the researcher's cultural and theoretical orientation. A high quality report will include a statement that clarifies this.

7. Influence of the researcher on the research, and vice-versa, is addressed

Is the potential for the researcher to influence the study and for the potential of the research process itself to influence the researcher and her/his interpretations acknowledged and addressed? For example:

Is the relationship between the researcher and the study participants addressed? Does the researcher critically examine her/his own role and potential influence during data collection? Is it reported how the researcher responded to events that arose during the study?

8. Representation of participants and their voices

Generally, reports should provide illustrations from the data to show the basis of their conclusions and to ensure that participants are represented in the report.

9. Ethical approval by an appropriate body

A statement on the ethical approval process followed should be in the report.

10. Relationship of conclusions to analysis, or interpretation of the data

This criterion concerns the relationship between the findings reported and the views or words of study participants. In appraising a paper, appraisers seek to satisfy themselves that the conclusions drawn by the research are based on the data collected; data being the text generated through observation, interviews or other processes.

4. JBI Checklist for Analytical Cross-Sectional Studies

JBI Critical Appraisal Checklist for Analytical Cross Sectional Studies

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not applicable
1. Were the criteria for inclusion in the sample clearly defined?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the study subjects and the setting described in detail?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the exposure measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were objective, standard criteria used for measurement of the condition?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were confounding factors identified?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were strategies to deal with confounding factors stated?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes measured in a valid and reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

Explanation of analytical cross sectional studies critical appraisal

How to cite: Moola S, Munn Z, Tufanaru C, Aromataris E, Sears K, Sfetcu R, Currie M, Qureshi R, Mattis P, Lisy K, Mu P-F. Chapter 7: Systematic reviews of etiology and risk . In: Aromataris E, Munn Z (Editors). *Joanna Briggs Institute Reviewer's Manual*. The Joanna Briggs Institute, 2017. Available from <https://reviewersmanual.joannabriggs.org/>

Analytical cross sectional studies Critical Appraisal Tool

Answers: Yes, No, Unclear or Not/Applicable

1. Were the criteria for inclusion in the sample clearly defined?

The authors should provide clear inclusion and exclusion criteria that they developed prior to recruitment of the study participants. The inclusion/exclusion criteria should be specified (e.g., risk, stage of disease progression) with sufficient detail and all the necessary information critical to the study.

2. Were the study subjects and the setting described in detail?

The study sample should be described in sufficient detail so that other researchers can determine if it is comparable to the population of interest to them. The authors should provide a clear description of the population from which the study participants were selected or recruited, including demographics, location, and time period.

3. Was the exposure measured in a valid and reliable way?

The study should clearly describe the method of measurement of exposure. Assessing validity requires that a 'gold standard' is available to which the measure can be compared. The validity of exposure measurement usually relates to whether a current measure is appropriate or whether a measure of past exposure is needed.

Reliability refers to the processes included in an epidemiological study to check repeatability of measurements of the exposures. These usually include intra-observer reliability and inter-observer reliability.

4. Were objective, standard criteria used for measurement of the condition?

It is useful to determine if patients were included in the study based on either a specified diagnosis or definition. This is more likely to decrease the risk of bias. Characteristics are another useful approach to matching groups, and studies that did not use specified diagnostic methods or definitions should provide evidence on matching by key characteristics.

5. Were confounding factors identified?

Confounding has occurred where the estimated intervention exposure effect is biased by the presence of some difference between the comparison groups (apart from the exposure investigated/of interest). Typical confounders include baseline characteristics, prognostic factors, or concomitant exposures (e.g. smoking). A confounder is a difference between the comparison groups and it influences the direction of the study results. A high quality study at the level of cohort design will identify the potential confounders and measure them (where possible). This is difficult for studies where behavioral, attitudinal or lifestyle factors may impact on the results.

6. Were strategies to deal with confounding factors stated?

Strategies to deal with effects of confounding factors may be dealt within the study design or in data analysis. By matching or stratifying sampling of participants, effects of confounding factors can be adjusted for. When dealing with adjustment in data analysis, assess the statistics used in the study. Most will be some form of multivariate regression analysis to account for the confounding factors measured.

7. Were the outcomes measured in a valid and reliable way?

Read the methods section of the paper. If for e.g. lung cancer is assessed based on existing definitions or diagnostic criteria, then the answer to this question is likely to be yes. If lung cancer is assessed using observer reported, or self-reported scales, the risk of over- or under-reporting is increased, and objectivity is compromised. Importantly, determine if the measurement tools used were validated instruments as this has a significant impact on outcome assessment validity.

Having established the objectivity of the outcome measurement (e.g. lung cancer) instrument, it's important to establish how the measurement was conducted. Were those involved in collecting data trained or educated in the use of the instrument/s? (e.g. radiographers). If there was more than one data collector, were they similar in terms of level of education, clinical or research experience, or level of responsibility in the piece of research being appraised?

8. Was appropriate statistical analysis used?

As with any consideration of statistical analysis, consideration should be given to whether there was a more appropriate alternate statistical method that could have been used. The methods section should be detailed enough for reviewers to identify which analytical techniques were used (in particular, regression or stratification) and how specific confounders were measured.

For studies utilizing regression analysis, it is useful to identify if the study identified which variables were included and how they related to the outcome. If stratification was the analytical approach used, were the strata of analysis defined by the specified variables? Additionally, it is also important to assess the appropriateness of the analytical strategy in terms of the assumptions associated with the approach as differing methods of analysis are based on differing assumptions about the data and how it will respond.

Appendix F: Critical appraisal tables – scores

1. Quasi-experimental Studies

	Quasi-Experimental Design Methodological quality criteria	Diedhiou et al., 2015	Limaye et al., 2015	Otu et al., 2015	Pimmer et al., 2016	McConnell et al., 2017	Rahimi, Fahami & Najimi, 2017
1	Is it clear in the study what is the "cause" and what is the "effect"?	Yes	Yes	Yes	Yes	Yes	Yes
2	Were the participants included in any comparisons similar?	Yes	Yes	Yes	Yes	Yes	Yes
3	Were the participants included in any comparisons receiving similar treatment / care, other than the exposure or intervention of interest?	N/A	N/A	N/A	N/A	N/A	Yes
4	Was there a control group?	No	No	No	No	No	Yes
5	Were there multiple measurements of the outcome both pre and post the intervention / exposure?	Yes	Yes	Yes	Yes	Yes	Yes
6	Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Yes	Unclear	Yes	Yes	Yes	Unclear
7	Were outcomes of participants included in any comparisons measured in the same way?	N/A	N/A	N/A	N/A	N/A	Yes
8	Were outcomes measured in a reliable way?	Yes	Unclear	Yes	Yes	Yes	Unclear
9	Was appropriate statistical analysis used?	Yes	Unclear	Yes	Yes	Yes	Yes
	Total	6/9	3/9	6/9	6/9	6/9	7/9

2. Randomised Controlled Trials

RCT Design Methodological quality criteria	Sranacharoenpong et al., 2009	Chen et al., 2014	Mastellos et al., 2018	O'Donovan et al., 2018
Was true randomization used for assignment of participants to treatment groups?	Yes	Yes	Yes	Yes
Was allocation to treatment groups concealed?	Unclear	Yes	Unclear	No
Were treatment groups similar at the baseline?	Yes	Yes	Yes	Yes
Were participants blind to treatment assignment?	No	No	Yes	No
Were those delivering treatment blind to treatment assignment?	No	No	No	No
Were outcome assessors blind to treatment assignment?	No	Unclear	Yes	Yes
Were treatment groups treated identically other than the intervention of interest?	Unclear	Yes	Yes	Yes
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Yes	No	Yes	Yes
Were participants analyzed in the groups to which they were randomised?	Yes	Yes	Yes	Yes
Were outcomes measured in the same way for treatment groups?	Yes	Yes	Yes	Yes
Were outcomes measured in a reliable way?	Yes	Unclear	Yes	Yes
Was appropriate statistical analysis used?	Yes	Yes	Yes	Yes
Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	Yes	Yes	Yes	Yes
Total	8/13	8/13	11/13	10/13

3. Cross-sectional Studies

Cross-sectional Design Methodological criteria	Woods et al., 2012	Chipps et al., 2015	Asgary et al., 2016	Yeates et al., 2016
Were the criteria for inclusion in the sample clearly defined?	No	Yes	Yes	Yes
Were the study subjects and the setting described in detail?	Unclear	Yes	Yes	Yes
Was the exposure measured in a valid and reliable way?	Unclear	N/A	Yes	Yes
Were objective, standard criteria used for measurement of the condition?	No	Yes	Yes	Yes
Were confounding factors identified?	No	No	No	No
Were strategies to deal with confounding factors stated?	No	No	No	No
Were the outcomes measured in a valid and reliable way?	Yes	Yes	Yes	Yes
Was appropriate statistical analysis used?	Unclear	N/A	Yes	Yes
Total	1/8	4/8	6/8	6/8

4. Qualitative Studies

Qualitative Design Methodological criteria	3. Bellina et al., 2014	15. Pimmer & Mbvundula, 2018
Is there congruity between the stated philosophical perspective and the research methodology?	Unclear	Yes
Is there congruity between the research methodology and the research question or objectives?	Yes	Yes
Is there congruity between the research methodology and the methods used to collect data?	Unclear	Yes
Is there congruity between the research methodology and the representation and analysis of data?	Unclear	Yes
Is there congruence between the research methodology and the interpretation of results?	Unclear	Yes
Is there a statement locating the researcher culturally or theoretically?	No	Yes
Is the influence of the researcher on the research, and vice versa, addressed?	No	Unclear
Are participants, and their voices, adequately represented?	No	Yes
Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?	No	Yes
Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?	Yes	Yes
Total	1/10	9/10

Submission Guidelines

Review

Criteria

Reviews provide comprehensive and authoritative coverage of a topic area.

Key aims of reviews are to provide systematic and substantial coverage of mature subjects, evaluations of progress in specified areas, and/or critical assessments of emerging technologies.

All articles published in *Human Resources for Health* have a maximum word limit of 4,000 words regardless of article type, which excludes text in tables, figures and additional files. Authors are encouraged to avoid repeating unnecessarily information in the main article if it is present in any tables or figures.

Additional non-English language abstract

An additional non-English language abstract can be included within the article. The additional abstract should be placed after the official English language abstract in the submitted manuscript file and should not exceed 350 words. Please ensure you indicate the language of your abstract. In addition to English, we can support German, Spanish, French, Norwegian and Portuguese abstracts.

Preparing your manuscript

The information below details the section headings that you should include in your manuscript and what information should be within each section.

Please note that your manuscript must include a 'Declarations' section including all of the subheadings (please see below for more information).

Title page

The title page should: present a title that includes, if appropriate, the study design e.g.: "A versus B in the treatment of C: a randomised controlled trial", "X is a risk factor for Y: a case control study", "What is the impact of factor X on subject Y: A systematic review" or for non-clinical or non-research studies: a description of what the article reports list the full names, institutional addresses and email addresses for all authors if a collaboration group should be listed as an author, please list the Group name as an author. If you would like the names of the individual members of the Group to be searchable through their individual PubMed records, please include this information in the "Acknowledgements" section in accordance with the instructions below indicate the corresponding author.

Abstract

The Abstract should not exceed 350 words and should be structured with a background, main body of the abstract and short conclusion. Please minimize the use of abbreviations and do not cite references in the abstract.

Keywords

Three to ten keywords representing the main content of the article.

Background

The Background section should explain the background to the article, its aims, a summary of a search of the existing literature and the issue under discussion.

Main text

This should contain the body of the article, and may also be broken into subsections with short, informative headings.

Conclusions

This should state clearly the main conclusions and include an explanation of their relevance or importance to the field.

List of abbreviations

If abbreviations are used in the text they should be defined in the text at first use, and a list of abbreviations should be provided.

Declarations

All manuscripts must contain the following sections under the heading 'Declarations':

Ethics approval and consent to participate

Consent for publication

Availability of data and material

Competing interests

Funding

Authors' contributions

Acknowledgements

Authors' information (optional)

Please see below for details on the information to be included in these sections.

If any of the sections are not relevant to your manuscript, please include the heading and write 'Not applicable' for that section.

Ethics approval and consent to participate

Manuscripts reporting studies involving human participants, human data or human tissue must:

include a statement on ethics approval and consent (even where the need for approval was waived)

include the name of the ethics committee that approved the study and the committee's reference number if

appropriate

Studies involving animals must include a statement on ethics approval.

See our editorial policies for more information.

If your manuscript does not report on or involve the use of any animal or human data or tissue, please state "Not applicable" in this section.

Consent for publication

If your manuscript contains any individual person's data in any form (including any individual details, images or videos), consent for publication must be obtained from that person, or in the case of children, their parent or legal guardian. All presentations of case reports must have consent for publication. You can use your institutional consent form or our consent form if you prefer. You should not send the form to us on submission, but we may request to see a copy at any stage (including after publication).

See our editorial policies for more information on consent for publication.

If your manuscript does not contain data from any individual person, please state "Not applicable" in this section.

Availability of data and materials

All manuscripts must include an 'Availability of data and materials' statement. Data availability statements should include information on where data supporting the results reported in the article can be found including, where applicable, hyperlinks to publicly archived datasets analysed or generated during the study. By data we mean the minimal dataset that would be necessary to interpret, replicate and build upon the findings reported in the article. We recognise it is not always possible to share research data publicly, for instance when individual privacy could be compromised, and in such instances data availability should still be stated in the manuscript along with any conditions for access. Data availability statements can take one of the following forms (or a combination of more than one if required for multiple datasets):

The datasets generated and/or analysed during the current study are available in the [NAME] repository, [PERSISTENT WEB LINK TO DATASETS].

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

All data generated or analysed during this study are included in this published article [and its supplementary information files].

The datasets generated and/or analysed during the current study are not publicly available due [REASON WHY DATA ARE NOT PUBLIC] but are available from the corresponding author on reasonable request.

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

The data that support the findings of this study are available from [third party name] but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of [third party name].

Not applicable. If your manuscript does not contain any data, please state 'Not applicable' in this section.

More examples of template data availability statements, which include examples of openly available and restricted access datasets, are available here.

BioMed Central also requires that authors cite any publicly available data on which the conclusions of the paper rely in the manuscript. Data citations should include a persistent identifier (such as a DOI) and should ideally be included in the reference list.

Citations of datasets, when they appear in the reference list, should include the minimum information recommended by DataCite and follow journal style. Dataset identifiers including DOIs should be expressed as full URLs. For example:

Hao Z, AghaKouchak A, Nakhjiri N, Farahmand A. Global integrated drought monitoring and prediction system (GIDMaPS) data sets. figshare. 2014.

<http://dx.doi.org/10.6084/m9.figshare.853801>

With the corresponding text in the Availability of data and materials statement:

The datasets generated during and/or analysed during the current study are available in the [NAME] repository, [PERSISTENT WEB LINK TO DATASETS].[Reference number]

Competing interests

All financial and non-financial competing interests must be declared in this section.

See our editorial policies for a full explanation of competing interests. If you are unsure whether you or any of your co-authors have a competing interest please contact the editorial office. Please use the authors initials to refer to each authors' competing interests in this section. If you do not have any competing interests, please state "The authors declare that they have no competing interests" in this section.

Funding

All sources of funding for the research reported should be declared. The role of the funding body in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript should be declared.

Authors' contributions

The individual contributions of authors to the manuscript should be specified in this section. Guidance and criteria for authorship can be found in our editorial policies. Please use initials to refer to each author's contribution in this section, for example: "FC analyzed and interpreted the patient data regarding the hematological disease and the transplant. RH performed the histological examination of the kidney, and was a major contributor in writing the manuscript. All authors read and approved the final manuscript."

Acknowledgements

Please acknowledge anyone who contributed towards the article who does not meet the criteria for authorship including anyone who provided professional writing services or materials. Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements section. See our editorial policies for a full explanation of acknowledgements and authorship criteria. If you do not have anyone to acknowledge, please write "Not applicable" in this section. Group authorship (for manuscripts involving a collaboration group): if you would like the names of the individual members of a collaboration Group to be searchable through their individual PubMed records, please ensure that the title of the collaboration Group is included on the title page and in the submission system and also include collaborating author names as the last paragraph of the "Acknowledgements" section. Please add authors in the format First Name, Middle initial(s) (optional), Last Name. You can add institution or country information for each author if you wish, but this should be consistent across all authors.

Please note that individual names may not be present in the PubMed record at the time a published article is initially included in PubMed as it takes PubMed additional time to code this information.

Authors' information

This section is optional.

You may choose to use this section to include any relevant information about the author(s) that may aid the reader's interpretation of the article, and understand the standpoint of the author(s). This may include details about the authors' qualifications, current positions they hold at institutions or societies, or any other relevant background information. Please refer to authors using their initials. Note this section should not be used to describe any competing interests.

Endnotes

Endnotes should be designated within the text using a superscript lowercase letter and all notes (along with their corresponding letter) should be included in the Endnotes section. Please format this section in a paragraph rather than a list.

References

Examples of the Vancouver reference style are shown below.

See our editorial policies for author guidance on good citation practice.

Web links and URLs: All web links and URLs, including links to the authors' own websites, should be given a reference number and included in the reference list rather than within the text of the manuscript. They should be provided in full, including both the title of the site and the URL, as well as the date the site was accessed, in the following

format: The Mouse Tumor Biology Database.

<http://tumor.informatics.jax.org/mtbwi/index.do>. Accessed 20 May 2013. If an author or group of authors can clearly be associated with a web link, such as for weblogs, then they should be included in the reference.

Example reference style:

Article within a journal

Smith JJ. The world of science. *Am J Sci*. 1999;36:234-5.

Article within a journal (no page numbers)

Rohrmann S, Overvad K, Bueno-de-Mesquita HB, Jakobsen MU, Egeberg R, Tjønneland A, et al. Meat consumption and mortality - results from the European Prospective Investigation into Cancer and Nutrition. *BMC Medicine*. 2013;11:63.

Article within a journal by DOI

Slifka MK, Whitton JL. Clinical implications of dysregulated cytokine production. *Dig J Mol Med*. 2000; doi:10.1007/s801090000086.

Article within a journal supplement

Frumin AM, Nussbaum J, Esposito M. Functional asplenia: demonstration of splenic activity by bone marrow scan. *Blood* 1979;59 Suppl 1:26-32.

Book chapter, or an article within a book

Wyllie AH, Kerr JFR, Currie AR. Cell death: the significance of apoptosis. In: Bourne GH, Danielli JF, Jeon KW, editors. *International review of cytology*. London: Academic; 1980. p. 251-306.

OnlineFirst chapter in a series (without a volume designation but with a DOI)

Saito Y, Hyuga H. Rate equation approaches to amplification of enantiomeric excess and chiral symmetry breaking. *Top Curr Chem*. 2007. doi:10.1007/128_2006_108.

Complete book, authored

Blenkinsopp A, Paxton P. *Symptoms in the pharmacy: a guide to the management of common illness*. 3rd ed. Oxford: Blackwell Science; 1998.

Online document

Doe J. Title of subordinate document. In: *The dictionary of substances and their effects*. Royal Society of Chemistry. 1999. <http://www.rsc.org/dose/title of subordinate document>. Accessed 15 Jan 1999.

Online database

Healthwise Knowledgebase. *US Pharmacopeia*, Rockville. 1998. <http://www.healthwise.org>. Accessed 21 Sept 1998.

Supplementary material/private homepage

Doe J. Title of supplementary material. 2000. <http://www.privatehomepage.com>. Accessed 22 Feb 2000.

University site

Doe, J: Title of preprint. <http://www.uni-heidelberg.de/mydata.html> (1999). Accessed 25 Dec 1999.

FTP site

Doe, J: Trivial HTTP, RFC2169. <ftp://ftp.isi.edu/in-notes/rfc2169.txt> (1999). Accessed 12 Nov 1999.

Organization site

ISSN International Centre: The ISSN register. <http://www.issn.org> (2006). Accessed 20 Feb 2007.

Dataset with persistent identifier

Zheng L-Y, Guo X-S, He B, Sun L-J, Peng Y, Dong S-S, et al. Genome data from sweet and grain sorghum (*Sorghum bicolor*). *GigaScience Database*. 2011. <http://dx.doi.org/10.5524/100012>.

Figures, tables and additional files

See General formatting guidelines for information on how to format figures, tables and additional files.

Submit your manuscript in Editorial Manager

Published in collaboration with the World Health Organization

Submit a manuscript

Editorial Board

Sign up for article alerts and news from this journal

Follow

Follow us on Twitter

2017 Journal Metrics

Speed

124.1 days from submission to first decision

261 days from submission to acceptance

17.9 days from acceptance to publication

Citation Impact

2.440 - 2-year Impact Factor

2.882 - 5-year Impact Factor

1.431 - Source Normalized Impact per Paper (SNIP)

1.301 - SCImago Journal Rank (SJR)

Usage

992,080 downloads

1805 Altmetric mentions

More about our metrics

Human Resources for Health

ISSN: 1478-4491