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Mobile-based technologies to support healthcare provider to healthcare provider communication and management of care (Protocol)

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[Intervention Protocol]

Mobile-based technologies to support healthcare provider to healthcare provider communication and management of care

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ABSTRACT

This is a protocol for a Cochrane Review (Intervention). The objectives are as follows:

To assess the effects of mobile-based technologies versus standard practice for supporting communication and client management in healthcare providers.

BACKGROUND

Effective communication with other healthcare providers is essential for increasing health services capacity and providing optimal care, especially in areas where there is a shortage of healthcare providers (AAP 2015). The widespread use of information and communication technologies can potentially expand the use of telemedicine approaches to overcome networking gaps between healthcare providers and increase the capacity of health services.

Description of the condition

By 2035, there will be a worldwide shortage of approximately 12.9 million skilled healthcare providers (Campbell 2013). The biggest gaps occur in Southeast Asia and Sub-Saharan Africa, but elsewhere too, ageing populations, rising prevalence of non-communicable diseases, migration patterns and high turnover of healthcare providers all contribute to a worldwide shortage of healthcare providers in remote and rural areas, where populations are likely to be poorer, sicker and less educated (OPHI 2017; Wu 2016). Healthcare providers in those settings can be isolated and have scarce interaction with colleagues and specialists, with few opportunities for mentoring, consultation with experts, or referrals to other healthcare providers.

Description of the intervention

Telemedicine is defined as the use of information and communication technologies for medical diagnostic, monitoring and therapeutic purposes, when participants are separated by distance and/or time, with the ultimate goal of improving the health of individuals and communities (Hersh 2006). Although telemedicine and telehealth have been conceptualised separately, with the latter being a broader term that also encapsulates non-clinical activities such as professional education, the terms are often used synonymously (Hersh 2006; WHO 2016). The definition for mobile health (mHealth) has emerged more recently and refers to the use of mobile telecommunication technologies for delivering healthcare (Steinhubi 2013).

The exchange of information can happen synchronously (when interactions happen in real time) or asynchronously (when there is a lag between the clinical information being transmitted and the response) and through different channels, including videoconferencing, mobile applications, and secure messaging (Kruse 2017; WHO 2016). The most common examples of telemedicine services are store and forward services, where medical data is transmitted to a healthcare provider for offline assessment; remote monitoring services, where a healthcare provider uses technologies to monitor a person at a distance; and interactive services, where there is real-time interaction between a person and their healthcare provider (WHO 2012; WHO in press).

The World Health Organization (WHO) conducted a global survey on eHealth (WHO 2016), in which the terms telehealth and telemedicine were used interchangeably. Results showed that 57% of the 122 surveyed countries used telehealth as part of the national eHealth policy or strategy, and 22% had a dedicated national telehealth policy or strategy (WHO 2016). The most common areas were teleradiology, telepathology, remote patient monitoring and teledermatology, all of which were in use in more than half of the surveyed countries (WHO 2016). Of those, teleradiology programmes were most established, whereas the other programme types were mainly informal or at the pilot stage.

In a bid to maximise the coverage of healthcare services, decrease the costs associated with providing healthcare and optimise the shortage of healthcare professionals, governments and healthcare agencies all over the world have been funding telehealth programmes in countries of all income brackets. Some examples include the Technology Enabled Care Services programme in England (NHS Commissioning Assembly 2015), the Scottish Centre for Telehealth and Telecare (SCTT 2017), the Telehealth pilot programmes in Australia (Australian Govt Dept of Health), the telehealth services provided within the Medicare programme in the USA (MedPAC 2016), the Asia eHealth Information Network (AeHIN 20017), and the KwaZulu-Natal Experience in South Africa (Mars 2012).

How the intervention might work

The use of telemedicine between healthcare providers for communication, consultations and client management might contribute to developing professional skills and expertise, as well as optimising multidisciplinary communication (AAP 2015). This is particularly relevant for settings where there is a shortage of healthcare providers, for instance in low- and middle-income countries and in rural and remote areas. By enabling healthcare providers who are geographically separated to exchange clinical information, telemedicine can improve their performance, as well as foster the uniformity of clinical practice and facilitate universal health coverage. Technological advances and better telecommunication systems allow for broader and less expensive access to remotely delivered healthcare, making the intervention more accessible.

Notwithstanding the possibilities, telemedicine applications have been inconsistently implemented, with varying degrees of success due to technological challenges, legal considerations, human and cultural factors, and uncertainty around economic benefits and cost-effectiveness (WHO 2011). A global eHealth survey from 2016 reported that lack of funding, infrastructure, prioritisation, and legislation or regulations were the most common barriers to implementing telehealth programmes (WHO 2016). Overcoming these barriers requires the implementation of comprehensive regulatory guidelines, driven both by governmental and professional medical organisations; legislation on confidentiality, privacy and liability; and the involvement of all stakeholders in designing, implementing and evaluating telemedicine applications, focusing on the safety and the effectiveness of applications (Agboola 2016; WHO 2011).

Why it is important to do this review

The rapid progress in information and communication technologies is accelerating the evolution of telemedicine. Despite its potential and the exponential growth of telemedicine applications in the last decades, there are still unanswered questions about its effectiveness. The rationale for conducting this review is to assess the effectiveness of mobile technologies as a method for healthcare providers to communicate, diagnose and manage clients. Although these technologies are now ubiquitous, their rapid expansion has not been accompanied by a close assessment of their impact, which led the WHO to commission guidelines to inform investments of digital health applications for strengthening health systems. This review is one of a suite of six Cochrane Reviews that will contribute to those guidelines. We aim to assess the effectiveness of telemedicine not only on communication between healthcare providers, but also acceptability, satisfaction, resources use and unintended consequences. Research into the latter has been particularly neglected but can provide crucial information for implementing successful telemedicine programmes.

OBJECTIVES

To assess the effects of mobile-based technologies versus standard practice for supporting communication and client management in healthcare providers.

METHODS

Criteria for considering studies for this review

Types of studies

We will include randomised trials reported as full-text studies, conference abstracts and unpublished data, irrespective of their publication status and language of publication.

Types of participants

All types of healthcare providers (i.e. professionals, paraprofessionals and lay health workers) providing client care through mobile-based technologies. We will include studies targeting patients with any condition, regardless of their location, setting, diagnoses, or demographic factors such as age. We will not include studies where the primary purpose is education or training.

Types of interventions

We will include trials comparing healthcare delivered through a mobile device versus standard care, which we define as usual care for the setting where the study took place, including face-to-face exchanges and communication through other non-digital channels.

By mobile-based technologies for healthcare providers to communicate and manage clients, we mean healthcare providers who are geographically separated using information and communication technologies. We will focus exclusively on engagement where the healthcare provider enquiry receives a response in real-time or as immediate as clinically appropriate.

We will focus exclusively on clinical information that professionals can exchange over wireless and mobile technologies, mobile phones of any kind (but not analogue landline telephones), tablets, personal digital assistants and smartphones. Communication channels via mobile device can include text messaging, video messaging, social media, voice calls, voice over Internet Protocol (VoIP), and videoconferencing, through software such as Skype, WhatsApp or Google Hangouts.

We will include:

- studies in which the healthcare provider uses telemedicine to seek clinical guidance and support from other qualified healthcare providers in order to deliver direct patient care. This would include coordination of referrals and requests for expert opinion and diagnosis;
- studies in which the provider(s) seeking guidance is at a different location from the provider(s) offering guidance; and
- studies in which the provider(s) seeking guidance transmits clinical information via a mobile device and the provider(s) offering guidance responds on any device, including stationary devices.

We will include studies assessing unspecified types of communication devices for transmitting the clinical information, since studies often fail to report this detail.

We will include all health issues and will not restrict the content of clinical health information exchanged. We will include studies where the digital component of the intervention is delivered as part of a wider package if we have judged it to be the core component of the intervention.

We will exclude:

- pilot and feasibility studies (pilot study defined as "a version of the main study that is run in miniature to test whether the components of the main study can all work together" and feasibility study as "pieces of research done before a main study"; Arain 2010);
- studies that compare different technical specifications of telecommunication technologies (e.g. different communication channels, software, etc.);
- studies in which the use of telecommunications technology is not directly linked to patient care;
- studies in which the primary purpose is education/training;
- studies assessing the accuracy of a portable medical device.

Types of outcome measures

Primary outcomes

1. Providers' adherence to recommended practice, guidelines or protocols (for example, providing the service at the recommended time, referral as recommended, screening and prioritising groups of clients as recommended).
2. Time between presentation and appropriate management.

Secondary outcomes

1. Clients' health status and well-being, using validated measures, such as the Notthingham Health Profile or the SF-36 (McDowell 2006).
2. Healthcare provider acceptance of and satisfaction with the intervention; this will include both objective measures, such as the number of dropouts not explained by other reasons, and self-reported acceptability and satisfaction, measured with a validated scale, such as the Physician Worklife Survey (Konrad 1999).

3. Client acceptability and satisfaction; this will include both objective measures, such as the number of dropouts not explained by other reasons, and self-reported acceptability and satisfaction, measured with a validated scale, such as the Patient Satisfaction Scale (La Monica 1986).

4. Resource use, including cost to the user and cost to the service (e.g. human resources/time, training, supplies and equipment). This measure will need to be pre-specified and available directly from the Results section.

5. Unintended consequences. These could include: misreading or misinterpretation of data; transmission of inaccurate data; loss of verbal and non-verbal communication cues, including between provider and user; issues of privacy and disclosure; affecting interpersonal relationships; negative impacts on equity; failure or delay in the message delivery.

Search methods for identification of studies

Electronic searches

An information specialist developed the search strategies in consultation with the review authors and WHO content experts. We will use a minimum cutoff search date of 2000, based on the increased availability and penetration of mobile devices used for telemedicine from that date on (ITU 2017). Appendix 1 lists the search strategy for MEDLINE. We will search the following databases.

- Cochrane Central Register of Controlled Trials (CENTRAL; latest issue), in the Cochrane Library.
- MEDLINE Ovid.
- Embase Ovid.
- POPLINE.
- WHO Global Health Library.

Searching other resources

Trial registries

We will search clinicaltrials.gov (clinicaltrials.gov) and the World Health Organization International Clinical Trials Registry Platform (who.int/ictrp).

Grey literature

We will also conduct a grey literature search to identify studies not indexed in the databases listed above. We will search for relevant systematic reviews and primary studies on similar topics using Epistemonikos (epistemonikos.org), which is a database of health evidence and a large source of health-related systematic reviews. We will search all the contributed content in mHealthEvidence (mhealthevidence.org), a database of global literature on mHealth. We will contact authors of relevant studies/reviews to clarify reported published information and to seek unpublished results/ data as well as researchers with expertise relevant to the review topic. Moreover, WHO will issue a call for papers through popular digital health communities of practice such as the Global Digital Health Network and Implementing Best Practices, to identify additional primary studies as well as grey literature.

Data collection and analysis

Selection of studies

We will download all titles and abstracts retrieved by electronic searching to a reference management database and remove duplicates. For title and abstract screening, we will use a machine learning classifier that is able to assign a probability score that a given record describes, or does not describe, a randomised trial (Wallace 2017). Two review authors (of BB, NH, NM) will screen titles and abstracts of studies with at least a 10% probability of being a randomised trial, and one review author will screen those with less than a 10% probability. We will retrieve the full-text study reports/publication of all potentially eligible reports, and two review authors (of BB, NH, NM) will independently screen the full text to identify studies for inclusion and to identify and record reasons for excluding the ineligible studies. We will resolve any disagreement through discussion, and if required we will consult a third review author (DGB or SS).

We will list studies that initially appeared to meet the inclusion criteria but that we later excluded in the 'Characteristics of excluded studies' table. We will collate multiple reports of the same study so that each study rather than each report is the unit of interest in the review. We will also provide any information we can obtain about ongoing studies. We will record the selection process in sufficient detail to complete a PRISMA flow diagram (Liberati 2009).

Data extraction and management

We will use the EPOC standard data collection form and adapt it for study characteristics and outcome data (EPOC 2017a); we will pilot the form on at least one study in the review. Two review authors (of BB, NH, NM) will independently extract the following characteristics from the included studies.

1. Methods: study design, unit of allocation, location and study setting, withdrawals.

2. Participants: number, mean age, age range, sex, inclusion criteria, exclusion criteria, other relevant characteristics.

3. Interventions: function of the intervention (monitoring, consultation, therapy), intervention components (including type of technology and mode of delivery, frequency of data transmission), comparison, fidelity assessment. For this review,

we defined monitoring as the continuous evaluation of the progress of symptoms or a condition over a period of time; consultation as an exchange between the healthcare provider and the client, where the provider discusses the client's health status and provides guidance, support, or information; and therapy as the ongoing management and care of a client, to counteract a disease or disorder.

4. Outcomes: main outcomes specified and collected, time points reported.
5. Notes: funding for trial, ethical approval.

Two review authors (of BB, NH, NM) will independently extract outcome data from included studies. We will contact authors of included studies to seek missing data. We will note in the 'Characteristics of included studies' table if outcome data are reported in an unusable way. We will resolve disagreements by consensus or by involving a third review author (DGB or SS). We will group the studies by health condition being targeted. We will create a miscellaneous category for studies focusing on rare conditions and single studies of a condition, for which we will extract basic study information and descriptive data, but not outcome or risk of bias data.

Assessment of risk of bias in included studies

Two review authors (of BB, NH, NM) will independently assess risk of bias for each study using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2017), plus the guidance from the EPOC group (EPOC 2017b). We will resolve any disagreement by discussion or by involving a third review author (DGB or SS). We will assess the risk of bias according to the following domains.

1. Random sequence generation.
2. Allocation concealment.
3. Blinding of participants and personnel.
4. Blinding of outcome assessment.
5. Incomplete outcome data.
6. Selective outcome reporting.
7. Baseline outcomes measurement.
8. Baseline characteristics.
9. Other bias.

We will judge the risk of each potential source of bias as being high, low or unclear and provide a quotation from the study report together with a justification for our judgment in the 'Risk of bias' table. We will summarise the 'Risk of bias' judgments across different studies for each of the domains listed. We will consider blinding separately for different key outcomes where necessary (e.g. for unblinded outcome assessment, risk of bias for all-cause mortality may be very different than for a patient-reported pain scale). We will assess incomplete outcome data separately for different outcomes. Where information on risk of bias relates to unpublished data or correspondence with a trialist, we will note this in the 'Risk of bias' table. We will not exclude studies on the grounds of their risk of bias but will clearly report the risk of bias when presenting the results of the studies.

When considering treatment effects, we will take into account the risk of bias for the studies that contribute to that outcome.

We will conduct the review according to this published protocol and report any deviations form it in the 'Differences between protocol and review' section of the systematic review.

Measures of treatment effect

We will estimate the effect of the intervention using risk ratios and associated 95% confidence intervals for dichotomous data, and standardised mean differences and 95% confidence intervals for continuous data (Higgins 2011). We will ensure that readers can interpret an increase in scores for continuous outcomes in the same way for each outcome, explain the direction of effect, and report where the directions were reversed if this were necessary.

Unit of analysis issues

We will control for unit of analysis errors by reanalysing results after adjusting for clustering. If there is not enough information to reanalyse the results, we will try to contact the study authors in order to obtain the necessary data. If we are not able to access all the data we will not report confidence intervals or P values (EPOC 2017c).

Dealing with missing data

We will contact investigators in order to verify key study characteristics and obtain missing outcome data where possible (e.g. when a study report is only available as an abstract). We will try to compute missing summary data from other reported statistics. Whenever it is not possible to obtain data, we will report the level of missingness and consider how that might impact the certainty of the evidence.

Assessment of heterogeneity

If we find a sufficient number of studies we will conduct a meta-analysis. We will use the I^2 statistic to measure heterogeneity among the trials in each analysis. If we identify substantial heterogeneity, we will explore it by pre-specified subgroup analysis.

Assessment of reporting biases

We will attempt to contact study authors, asking them to provide missing outcome data. Where this is not possible, and we consider that the missing data can introduce serious bias, we will explore the impact of including such studies in the overall assessment of results**.** If we are able to pool more than 10 trials, we will create and examine a funnel plot to explore possible publication biases, interpreting the results with caution (Sterne 2011).

Data synthesis

We will undertake meta-analyses only where this is meaningful, that is, if the treatments, participants, and underlying clinical question are similar enough for pooling to make sense (Borenstein 2009). A common way that trialists indicate the presence of skewed data is by reporting medians and interquartile ranges. When we encounter this we will note that the data are skewed and consider the implications. Where a single trial reports multiple trial arms, we will include only the relevant arms. If two comparisons (e.g. intervention A versus usual care and intervention B versus usual care) must be entered into the same meta-analysis, we will halve the control group to avoid double-counting.

Subgroup analysis and investigation of heterogeneity

We plan to carry out the following subgroup analyses.

1. Healthcare provider type (e.g. lay versus professional healthcare provider). Lay health workers (LHW) often provide healthcare in settings where healthcare resources are scarcer, for example targeting epidemics in low- and middle-income countries and the specific health needs of minority communities in high-income countries (Lewin 2010). Because LHW have no formal professional tertiary education, their knowledge and beliefs might moderate the effects of the intervention (Akinlua 2016).
2. Type of communication channel (e.g. voice, SMS, interactive voice response, image exchange). Different communication channels might be used differently and serve distinct purposes (Ventola 2014), as well as providing a more comprehensive and realistic opportunity for communication.
3. Setting/income level (e.g. low-income versus high-income settings). Traditionally, the quality of healthcare is lower in low- and middle-income countries (Mills 2014), which might increase heterogeneity and preempt the pooled analysis of studies conducted in different settings.

We will use the following outcomes in subgroup analysis.

1. Providers' adherence to recommended practice, guidelines or protocols (for example, providing the service at the recommended time, linkage to referrals as recommended).
2. Time between presentation and appropriate management.
3. Clients' health status and well-being.

We will use the formal statistical techniques of Mantel-Haenszel and regression to test for subgroup interactions (Mantel 1959).

Sensitivity analysis

We will perform sensitivity analyses defined a priori to assess the robustness of our conclusions and explore the impact on effect sizes. This will involve restricting the analysis to published studies and to studies at low risk of bias.

Summary of findings table

Two review authors will independently assess the certainty of the evidence (high, moderate, low, and very low) using the five GRADE considerations (risk of bias, consistency of effect, imprecision, indirectness, and publication bias) (Guyatt 2008). We will use methods and recommendations described in the *Cochrane Handbook for Systematic Reviews of Interventions* (Schünemann 2017) and the EPOC worksheets (EPOC 2017d), using GRADEpro software (GRADEpro GDT). We will resolve disagreements on certainty ratings by discussion and provide justification for decisions to down- or upgrade the ratings using footnotes in the table, making comments to aid readers' understanding of the review where necessary. We will use plain language statements to report these findings in the review (EPOC 2017e).

We will create a 'Summary of findings' table for the main intervention comparison and include the following outcomes in order to draw conclusions about the certainty of the evidence within the text of the review: providers' adherence to recommended practice, guidelines or protocols; time between presentation and appropriate management; clients' healthcare status; provider acceptability or satisfaction with the intervention; resource use; and unintended consequences.

We will consider whether there is any additional outcome information that we were not able to incorporate into meta-analyses, note this in the comments and state if it supports or contradicts the information from the meta-analyses. If it is not possible to meta-analyse the data, we will summarise the results in the text.

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REFERENCES

Additional references

AAP 2015

American Academy of Pediatrics Comittee on Pediatric Workforce. The use of telemedicine to address access and physician workforce shortages. *Pediatrics* 2015;**136**(1): 202–9.

AeHIN 20017

Asia eHealth Information Network. Getting to know the Network. aehin.hingx.org/aehinaboutus (accessed 13 October 2017).

Agboola 2016

Agboola SO, Bates DW, Kvedar JC. Digital health and patient safety. *JAMA* 2016;**315**(16):1697–8.

Akinlua 2016

Akinlua JT, Meakin R, Fadahunsi P, Freemantle N. Beliefs of health care providers, lay health care providers and lay persons in Nigeria regarding hypertension: a systematic mixed studies review. *PLOS ONE* 2016;**11**(5):e0154287.

Arain 2010

Arain M, Campbell MJ, Cooper CL, Lancaster GA. What is a pilot or feasibility study? A review of current practice and editorial policy. *BMC Medical Research Methodology* 2010; **10**:67.

Australian Govt Dept of Health

Australian Government Department of Health. Telehealth Pilots Programme. health.gov.au/ehealth-nbntelehealth (accessed 13 October 2017).

Borenstein 2009

Borenstein M, Hedges LV, Higgins JPT, Rothstein HR. When does it make sense to perform a meta-analysis?. *Introduction to Meta-Analysis*. Chichester (UK): John Wiley & Sons, Ltd, 2009.

Campbell 2013

Campbell J, Dussault G, Buchan J, Pozo-Martin F, Guerra Arias M, Leone C, et al. A universal truth: no health without a workforce. Recife, Brazil: Third Global Forum on Human Resources for Health; 2013. Forum report. Geneva: Global Health Workforce & World Health Organization.

EPOC 2017a

Cochrane Effective Practice, Organisation of Care (EPOC). Data collection form. EPOC resources for review authors, 2017. epoc.cochrane.org/resources/epoc-resources-review-authors (accessed 31 August 2017).

EPOC 2017b

Cochrane Effective Practice, Organisation of Care (EPOC). Suggested risk of bias criteria for EPOC reviews. EPOC resources for review authors, 2017. epoc.cochrane.org/resources/epoc-resources-review-authors (accessed 31 August 2017).

EPOC 2017c

Cochrane Effective Practice, Organisation of Care (EPOC). Analysis in EPOC reviews. EPOC Resources for review authors, 2017. epoc.cochrane.org/resources/epoc-resources-review-authors (accessed 31 August 2017).

EPOC 2017d

Cochrane Effective Practice, Organisation of Care (EPOC). EPOC worksheets for preparing a 'Summary of findings' table using GRADE. EPOC resources for review authors, 2017. epoc.cochrane.org/resources/epoc-resources-review-authors (accessed 31 August 2017).

EPOC 2017e

Cochrane Effective Practice, Organisation of Care (EPOC). Reporting the effects of an intervention in EPOC reviews. EPOC Resources for review authors, 2017. epoc.cochrane.org/resources/epoc-resources-review-authors (accessed 31 August 2017).

GRADEpro GDT [Computer program]

McMaster University (developed by Evidence Prime). GRADEpro GDT. Version accessed prior to 20 December 2017. Hamilton (ON): McMaster University (developed by Evidence Prime), 2015.

Guyatt 2008

Guyatt GH, Oxman AD, Vist G, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE Working Group. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008;**336**(7650): 924–6.

Hersh 2006

Hersh WR, Hickam DH, Severance SM, Dana TL, Krages KP, Helfand M. Telemedicine for the medicare population: update. *Evidence Report/Technology Assessment* 2006;**131**: 1–41.

Higgins 2011

Higgins JPT, Green S, editor(s). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 (updated March 2011). The Cochrane Collaboration, 2011. Available from handbook.cochrane.org. The Cochrane Collaboration. Available from www.cochrane–handbook.org.

Higgins 2017

Higgins JPT, Altman DG, Sterne JAC (editors). Chapter 8: Assessing risk of bias in included studies. In: Higgins JPT, Churchill R, Chandler J, Cumpston MS editor(s). *Cochrane Handbook for Systematic Reviews of Interventions version 5.2.0 (updated June 2017). Available from www.training.cochrane.org/handbook*. Cochrane, 2017.

ITU 2017

International Telecomunications Union. Global ICT developments, 2001-2017. www.itu.int/en/ITU-D/Statistics/Documents/statistics/2017/ITU_Key_2005-2017_ICT_data.xls (accessed 31 August 2017).

Konrad 1999

Konrad TR, Williams ES, Linzer M, McMurray J, Pathman DE, Gerrity M, et al. Measuring physician job satisfaction

in a changing workplace and a challenging environment. *Medical Care* 1999;**37**(11):1174–82.

Kruse 2017
Kruse CS, Krowski N, Rodriguez B, Tran L, Vela J, Brooks M. Telehealth and patient satisfaction: A systematic review and narrative analysis. *BMJ Open* 2017;**7**(8):e016242.

La Monica 1986
La Monica E, Oberst MT, Madea AR, Wolf RM. Development of a patient satisfaction scale. *Research in Nursing & Health* 1986;**9**(1):43–50.

Lewin 2010
Lewin S, Munabi-Babigumira S, Glenton C, Daniels K, Bosch-Capblanch X, van Wyk BE, et al. Lay health workers in primary and community health care for maternal and child health and the management of infectious diseases. *Cochrane Database of Systematic Reviews* 2010, Issue 3. [DOI: 10.1002/14651858.CD004015.pub3

Liberati 2009
Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gotzsche PC, Ioannidis JP, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLOS Medicine* 2009;**6**(7):e1000100.

Mantel 1959
Mantel N, Haenszel W. Statistical aspects of the analysis of data from retrospective studies of disease. *Journal of the National Cancer Institute* 1959;**22**(4):719–48.

Mars 2012
Mars M. Building the capacity to build capacity in e-Health in Sub-Saharan Africa: the KwaZulu-Natal Experience. *Telemedicine Journal and e-Health* 2012;**18**(1):32–7.

McDowell 2006
McDowell I. *Measuring Health: A Guide to Rating Scales and Questionnaires*. 3rd Edition. New York (NY): Oxford University Press, 2006.

MedPAC 2016
Medicare Payment Advisory Commission (USA). Telehealth services and the Medicare program. Washington, DC (Columbia). Medicare Payment Advisory Commission; 2016 June. Report to the Congress: Medicare and the Health Care Delivery System. pp 227-60 www.medpac.gov/docs/default–source/reports/chapter–8–telehealth–services–and–the–medicare–program–june–2016–report–.pdf?sfvrsn=0 (accessed prior to 20 December 2017).

Mills 2014
Mills A. Health care systems in low- and middle-income countries. *New England Journal of Medicine* 2010;**370**(6):552–7.

NHS Commissioning Assembly 2015
NHS Commissioning Assembly. Technology Enabled Care Services: Resource for Commissioners, 2015. www.england.nhs.uk/wp-content/uploads/2014/12/TECS_FinalDraft_0901.pdf (accessed prior to 20 December 2017).

OPHI 2017
Alkire S, Robles G. Global Dimensional Povery Index 2017. Oxford Poverty & Human Development Initiative, ODID, 2017. Available from www.ophi.org.uk/wp-content/uploads/B47_Global_MPI_2017.pdf (accessed 13 October 2017).

Schünemann 2017
Schünemann HJ, Oxman AD, Higgins JPT, Vist GE, Glasziou P, Akl E, et al. on behalf of the Cochrane GRADEing Methods Group and the Cochrane Statistical Methods Group. Chapter 11: Completing 'Summary of findings' tables and grading the confidence in or quality of the evidence. In: Higgins JPT, Churchill R, Chandler J, Cumpston MS editor(s). *Cochrane Handbook for Systematic Reviews of Interventions version 5.2.0 (updated June 2017). Available from www.training.cochrane.org/handbook*. Cochrane, 2017.

SCTT 2017
Scottish Centre for Telehealth & Telecare. Programmes. sctt.org.uk/programmes (accessed 13 October 2017).

Steinhubi 2013
Steinhubi SR, Muse ED, Topol EJ. Can mobile health technologies transform health care?. *JAMA* 2013;**310**(22):2395–6.

Sterne 2011
Sterne JA, Sutton AJ, Ioannidis JP, Terrin N, Jones DR, Lau J, et al. Recommendations for examining and interpreting funnel plot asymmetry in meta-analyses of randomised controlled trials. *BMJ* 2011;**343**:d4002. [DOI: 10.1136/bmj.d4002

Ventola 2014
Ventola CL. Mobile devices and apps for health care professionals: uses and benefits. *Pharmacy and Therapeutics* 2014;**39**(5):356–64.

Wallace 2017
Wallace BC, Noel-Storr A, Marshall IJ, Cohen AM, Smalheiser NR, Thomas J. Identifying reports of randomized controlled trials (RCTs) via a hybrid machine learning and crowdsourcing approach. *Journal of the American Medical Informatics Association* 2017;**24**(6):1165–8.

WHO 2011
World Health Organization. Global Observatory for eHealth. Global Observatory for eHealth series - Volume 2. Telemedicine: Opportunities and developments in Member States. January 2011. www.who.int/goe/publications/ehealth_series_vol2/en/ (accessed 31 August 2017).

WHO 2012
World Health Organization and International Telecommunication Union. National eHealth strategy toolkit. 2012. www.itu.int/dms_pub/itu-d/opb/str/D-STR-E_HEALTH.05-2012-PDF-E.pdf (accessed 31 August 2017).

WHO 2016
World Health Organization. Global Observatory for eHealth. Global diffusion of eHealth: Making universal

health coverage achievable. Report of the third global survey on eHealth. 2016. www.who.int/goe/publications/global_diffusion/en/ (accessed 31 August 2017).

WHO in press
World Health Organization. WHO Classification of Digital Health Interventions. http://www.who.int/publications/en/ (in press).

Wu 2016
Wu Q, Zhao L, Ye X-C. Shortage of healthcare professionals in China. *BMJ* 2016;**354**:i4860.

* *Indicates the major publication for the study*

APPENDICES

Appendix 1. MEDLINE search strategy

Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R)
1 exp Health Personnel/
2 (((health or medical or healthcare) adj (personnel or worker* or auxiliar* or staff or professional*)) or doctor* or physician* or GP or general practitioner? or family doctor or nurse* or midwi* or clinical officer* or pharmacist* or dentist* or ((birth or childbirth or labor or labour) adj (attendant? or assistant?))).ti,ab,kw.
3 ((lay or voluntary or volunteer? or untrained or unlicensed or nonprofessional? or non professional?) adj5 (worker? or visitor? or attendant? or aide or aides or support$ or person$ or helper? or carer? or caregiver? or care giver? or consultant? or assistant? or staff)).ti,ab,kw.
4 (paraprofessional? or paramedic or paramedics or paramedical worker? or paramedical personnel or allied health personnel or allied health worker? or support worker? or home health aide?).ti,ab,kw.
5 ((community or village? or lay) adj3 (health worker? or health care worker? or healthcare worker?)).ti,ab,kw.
6 (doula? or douladural? or barefoot doctor?).ti,ab,kw.
7 1 or 2 or 3 or 4 or 5 or 6
8 Cell Phones/
9 Smartphone/
10 MP3-Player/
11 Computers, Handheld/
12 ((cell* or mobile*) adj1 (phone* or telephone* or technolog* or device*)).ti,ab,kw.
13 (handheld or hand-held).ti,ab,kw.
14 (smartphone* or smart-phone* or cellphone* or mobiles).ti,ab,kw.
15 ((personal adj1 digital) or (PDA adj3 (device* or assistant*)) or MP3 player* or MP4 player*).ti,ab,kw.
16 (samsung or nokia).ti,ab,kw.
17 (windows adj3 (mobile* or phone*)).ti,ab,kw.
18 android.ti,ab,kw.
19 (ipad* or i-pad* or ipod* or i-pod* or iphone* or i-phone*).ti,ab,kw.
20 (tablet* adj3 (device* or computer*)).ti,ab,kw.
21 Telemedicine/
22 Videoconferencing/ or Webcasts as topic/
23 Text Messaging/
24 Telenursing/
25 (mhealth or m-health or "mobile health" or ehealth or e-health or "electronic health").ti,ab,kw.

26 (telemedicine or tele-medicine or telehealth or tele-health or telecare or tele-care or telenursing or tele-nursing or telepsychiatry or tele-psychiatry or telemonitor* or tele-monitor* or teleconsult* or tele-consult* or telecounsel* or tele-counsel* or telecoach* or tele-coach*).ti,ab,kw.
27 (videoconferenc* or video-conferenc* or webcast* or web-cast*).ti,ab,kw.
28 (((text* or short or voice or multimedia or multi-media or electronic or instant) adj1 messag*) or instant messenger).ti,ab,kw.
29 (texting or texted or texter* or ((sms or mms) adj (service* or messag*)) or interactive voice response* or IVR or voice call* or callback* or voice over internet or VOIP).ti,ab,kw.
30 (Facebook or Twitter or Whatsapp* or Skyp* or YouTube or "You Tube" or Google Hangout*).ti,ab,kw.
31 Mobile Applications/
32 "mobile app*".ti,ab,kw.
33 Social Media/
34 (social adj (media or network*)).ti,ab,kw.
35 Reminder Systems/
36 (remind* adj3 (text* or system* or messag*)).ti,ab,kw.
37 Electronic Mail/
38 (electronic mail* or email* or e-mail or webmail).ti,ab,kw.
39 Medical informatics/ or Medical informatics applications/
40 Nursing informatics/ or Public health informatics/
41 ((medical or clinical or health or healthcare or nurs*) adj3 informatics).ti,ab,kw.
42 Multimedia/
43 Hypermedia/
44 Blogging/
45 (multimedia or multi-media or hypermedia or hyper-media or blog* or vlog* or weblog* or web-log*).ti,ab,kw.
46 Interactive Tutorial/
47 Computer-Assisted Instruction/
48 ((interactive or computer-assisted) adj1 (tutor* or technolog* or learn* or instruct* or software or communication)).ti,ab,kw.
49 or/8-48
50 randomized controlled trial.pt.
51 controlled clinical trial.pt.
52 randomized.ab.
53 placebo.ab.
54 drug therapy.fs.
55 randomly.ab.
56 trial.ab.
57 groups.ab.
58 or/50-57
59 exp animals/ not humans.sh.
60 58 not 59
61 7 and 49 and 60
62 limit 61 to yr="2000 -Current"

CONTRIBUTIONS OF AUTHORS

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Co-ordinating the protocol: DGB, SS

Writing the protocol: DGB, SS

Providing general advice on the protocol: BB, MF, CG, SL, NH, GM, NM, TT

Securing funding for the protocol: GM, TT

DECLARATIONS OF INTEREST

DGB: I was commissioned by the WHO to conduct this review.

BB: none known.

CG: none known.

NH: since June 2016 I have been employed by Cochrane Response, an evidence services unit operated by the Cochrane Collaboration and contracted by the WHO to produce this review.

SL: I am the Joint Co-ordinating Editor for the Cochrane Effective Practice and Organisation of Care Review Group.

NM: I previously worked for Enhanced Reviews Ltd, a company that conducts systematic reviews mostly for the public sector. Since June 2016 I have be employed by Cochrane Response, an evidence services unit operated by the Cochrane Collaboration and contracted by the WHO to produce this review.

GM: owns stock in Apple Computer.

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