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Effectiveness of mHealth to Increase Cervical Cancer Screening: Systematic Review of Interventions

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Abstract

Background

Estimated one million plus women worldwide are currently living with cervical cancer. Many of them have not any access to health services for prevention, curative treatment or palliative care. Actually, cervical cancer is a public health issue in Sub-Saharan Africa as the result of the highest incidence of HIV-infected women. Pilot mHealth projects have shown that mobiles phones improve communication, information-delivery and information-retrieval processes over vast distances between healthcare service providers and patients. This study reviewed whether mHealth interventions could improve cancer screening uptake in risk women.

Objectives

To assess the effectiveness of different mHeath (SMS, calls, letters and emails reminders) interventions to improving cervical cancer screening in risk women.

Search methods

We searched for studies in MEDLINE, Scorpus, PsychINFO, Cochrane Central Register of Controlled Trials (CENTRAL), CINAHL, World Health Organization Global Health Library regional index, Mobile Active http:// www.mobileactive.org, Web of Science and

Grey literature. In addition, hand-searching was performed for the original published version of this review.

Selection criteria

We included the following studies design: randomized control trials, quasi-experimental studies and non-randomized control trials assessing different mHealth interventions in improving cervical cancer screening outcomes.

Data collection and analysis

Two reviewers independently (JT and LM) identified and critically appraised all included studies. Study design, characteristics of study populations, interventions, controls and study results were extracted by two review authors. In addition, the risk of bias of included studies was assessed independently by two reviewers. We interpreted the results from meta-analysis. We reported the odds ratio with 95% CI.

Main results

We found 4731 studies in different electronic databases, 3004 studies were included after removing duplicated studies. Among them, 79 studies were fully assessed and then, 51 were excluded and 28 studies were assessed for eligibility criteria. 11 studies were excluded with reasons and 17 studies were included in meta-analysis. The overall results revealed that call reminders increased 44% of cervical cancer screening compared to the standard care, with p-value of 0.01. 8 studies were included in this meta-analysis and the total number of participants was 29477. Call reminders improved 89% of cervical cancer screening adherence, with highly statistical results (Test for overall effect: $Z = 5.23$, $P < 0.00001$). 3 studies and 1340 participants were included. Lastly, letter reminders improved 20 % of cervical cancer screening compared to the standard care. 8 studies and 345835 participants were found in the overall results. Therefore, this result was not statistically significant ($P=0.15$).

The overall evidence was judged as moderate and high when considering the effect of call reminders on cervical cancer screening and adherence to screen cervical cancer; therefore the impact of letter reminders on cervical cancer screening was very low.

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Authors' conclusions

This systematic review supports the use of call reminders in improving cervical cancer screening and adherence to testing. The main outcomes were graded as high level of evidence. Then, call reminders could be suggested to be encompassed in different national policy in screening cervical cancer in risk populations. The lack of sufficient evidence on the subject limits the reliability of the current cervical cancer screening guidelines for high risk women is the leading cause of diagnosing cervical cancer in the last stage. Further studies in this field will provide the sole for preventing cervical cancer. However, this review could orientate public health policy makers.

Key words: cervical cancer, mHealth, screening, pap-smear

Background

Description of the condition

An estimated one million-plus woman worldwide is currently living with cervical cancer (WHO 2016). Many of them have not any access to health services for prevention, curative treatment or palliative care (WHO 2016). Cervical cancer is a consequence of a long-term infection with human papillomavirus (HPV), and the majority of cervical cancer cases (>80%) are currently found in low- and middle-income countries (WHO 2016).

Nowadays, Cervical cancer constitutes a major health problem worldwide (Miller 2016). Recent studies have demonstrated cervical cancer is the leading cause of female cancer mortality and second most common cancer in women worldwide(Jemal 2013, Wenzel 2015) and It is responsible for 528,000 new cases of cancer and causes 270,000 deaths each year (WHO 2012). Several demographic, economical and behavioral risk factors have been studied in relation to cervical cancer (Ali-Risasi 2015). Most of them may influence the risk of cancer through their effects on the risk of HIV and HPV infection (Ali-Risasi 2015). Different studies have shown that HIV infection has been associated with an increased risk of cervical cancer (Kumakech 2015). Epidemiological studies have clearly established human papillomavirus (HPV) infection as the main cause of cervical cancer. In most studies, HPV16 and HPV18 are the predominant genotypes: they cause about 70 % of precancerous lesions and cervical cancer (Bouvard 2009, Ali-Risasi 2015). In fact, an increasing body of literature indicates that HIV-positive women have an increased risk of developing cervical cancer in comparison with their HIV-negative counterparts (Massad 2013,Denslow 2014). Sub-Saharan has the highest incidence of HIV-infected women, and then cervical cancer is most notable in the lower-resource countries of sub-Saharan Africa (WHO 2012). In sub-Saharan Africa, 34.8 new cases of cervical cancer are diagnosed per 100 000 women annually, and 22.5 per 100 000 women die from the disease (WHO 2012). Compared to North America where there are 6.6 new cases of cervical cancer diagnosed per 100 000

women annually, and 2.5 per 100 000 women die, Sub-Saharan Africa has 34.8 and 22.5 per 100 000 respectively (WHO 2012).With increasing attention to cervical cancer prevention in developing countries (Viviano 2017), several pilot screening programs have been initiated throughout sub-Saharan Africa (Rosser 2015). The World Health Organization (WHO) recommends a more aggressive cervical cancer screening (Sankaranarayanan 2001).

In fact, among all malignant tumours, cervical cancer is the one that is most easily preventable by screening (Arbyn 2012). The detection of cytological abnormalities by microscopic examination of "Pap smears", and the subsequent treatment of women with high-grade cytological abnormalities, avoids development of cancer (Miller 1993, Arbyn 2012). With increasing attention to cervical cancer prevention in developing countries, several pilot screening programs have been initiated throughout sub-Saharan Africa (Rosser 2015). Therefore, some challenges are associated with screening, ranging from low levels of cervical cancer screening due to poor access to organized screening, a lack of or low information on cervical cancer screening, stigma, women's perception of low threat of disease and overburdened health care facilities which lack equipment and are understaffed(Makin-Byrd 2011; Kivuti-Bitok 2013).

Description of the intervention

Mobile telecommunication technologies into the health arena is also known as mobile health, mHealth or eHealth(Gurman 2012). Mobile phone technology is increasingly viewed as a promising communication channel that offers the potential to improve health care delivery and promote behavior change among vulnerable populations (Gurman 2012).

Pilot mHealth projects have shown that, particularly in developing countries, mobile phones improve communication and information-delivery and information-retrieval processes over vast distances between healthcare service providers and patients (Tamrat 2012, Chib 2013). Mobiles provide remote access to healthcare facilities, facilitate trainings for, and consultations among, health workers, and allow for remote monitoring and surveillance to improve public health programs. This phenomenon has the potential to lead to an overall increase in the efficiency and effectiveness of under-resourced health infrastructures, ultimately translating into benefits for patients (Chib 2013).

SMS-based interventions enable patients and providers to ''interact'' via two-way communication. To date, this feature has been implemented in various ways. For example, most studies have used systems to automate the message delivery process for providers, ranging from fully automated clinical appointment reminders (Downer 2006) to staff developing and delivering the messages themselves. SMS interventions also have enabled patients to communicate with providers to confirm thier adherence to any health interventions or outcomes (Hardy 2011; Coomes 2012). Other studies have mixed SMS, call, email and letter reminders to improve health related outcomes. In fact, letter reminders could be used in network inaccessible areas or cellphone deprived women.

The use of mHealth to improve health related outcomes is receiving more attention

in public health as emerging evidence suggests reminder messages, call, email and letter can improve several health outcomes.

How the intervention might work

Individual and cultural factors, such as stigma, isolation, symptoms of illness, and psychological distress (Gonzalez 2011, Zelaya 2012, Cook 2015) may contribute then to non-adherence of cervical cancer screening.

mHealth interventions can potentially influence health-related behavior (and, in turn, health outcomes) via effecting changes in mediators of behavior change such as knowledge, attitudes, community peer norms, beliefs and self-efficacy(Shepherd 2011). SMS can be customized to fit the needs of specific individuals by delivering tailored messages that are more likely to catch the individual's attention and be perceived as personally relevant and interesting (Kreuter 2000). Then, mHealth plays an active role in one's health and medical care leads to better healthcare quality, better clinical health outcomes, and likely lower healthcare costs (Hibbard 2004). Interventions aimed at increasing patient involvement have shown beneficial effects on satisfaction and functional status (Green 1988, Coomes 2012), quality of life (Wagner 2001), perceived control over cervical cancer.

Why it is important to do this review

Studies have shown that well-organized cytological screening at the population level, every three to five years, and the incidence of cervical cancer can be reduced up to 80% (Franceschi 2005, Arbyn 2012). Furthermore, the vaccination against the most common oncogenic human papillomavirus (HPV) types, HPV-16 and HPV-18, could prevent development of up to 70% of cervical cancers worldwide (Harper 2004). Therefore, this vaccine is quite inaccessible in developing countries; by the way, the Pap smear reminds the cornerstone of cervical cancer screening in developing countries. Then, improving cervical screening through different behavioral intervention is the only way that could decrease drastically the morbidity and mortality of cervical cancer.

Eight studies exploring reasons women did not utilize cervical cancer screening were included. Women in Sub-Saharan Africa reported similar barriers despite cultural and language diversity in the region (Lim 2016). Women reported fear of screening procedure and negative outcome, low level of awareness of services, embarrassment and possible violation of privacy, lack of spousal support, societal stigmatization, cost of accessing services and health service factors like proximity to facility, facility navigation, waiting time and health care personnel attitude (Lim 2016).

Objectives

To assess the effectiveness of different mHeath(SMS, calls, letters and emails reminders) interventions to improving cervical cancer screening in risk women.

Methods

Criteria for considering studies for this review

Types of studies

- Randomized control trials
- Quasi-experimental studies
- Non randomized control trials

Types of participants

Women at risk of developing cervical cancer

Types of interventions

- SMS reminders
- Call reminders
- E-mail reminders
- Letter reminders

Types of outcome measures

Primary outcomes

- Pap smear uptake
- Adherence to test pap smear

Secondary outcomes

Proportion of abnormal pap smear

Search methods for identification of studies

(Cellular phone) OR (telephone) OR (mobile phone) OR (text messag*) OR (testing) OR (short messag*) OR (cell phones) OR (SMS) OR (short message service) OR (text) OR (mobile health) OR (telemedicine) OR (health) OR (health communication) OR (health education) OR (behavior) OR (ehealth)

(Uterine Cervical Neoplasm) OR (Cervical Neoplasms) OR (Cervical Neoplasm) OR (Cervix Neoplasms) OR (Cervix Neoplasm) OR (Cancer of the Uterine Cervix) OR (Cancer of the Cervix) OR (Cervical Cancer) OR (Uterine Cervical Cancer) OR (Cancer of Cervix) OR (Cervix Cancer)

(Test, Papanicolaou) OR (Pap Test) OR (Test, Pap) OR (Pap Smear) OR (Smear, Pap) OR (Papanicolaou Smear)

(Randomized controlled trial) OR (controlled clinical trial) OR (randomized controlled trials) OR (random allocation) OR (double-blind method) OR (single-blind method) OR (clinical trial) OR (trial) OR (clinical trials) OR (clinical trial) OR (singl* OR doubl*) OR (trebl* OR tripl*) AND (mask* OR blind*) OR (placebos) OR (placebo*) OR (random*)

Electronic searches

We searched for studies in:

- MEDLINE
- Scorpus
- PsychINFO
- Cochrane Central Register of Controlled Trials (CENTRAL)
- CINAHL
- World Health Organization Global Health Library regional index
- Mobile Active http:// www.mobileactive.org
- Web of Science
- Grey literature

Searching other resources

Hand-searching was performed for the original published version of this review, but not for this update. Issues of the following journals was hand-searched: AIDS, AIDS Care, Health Education Journal, Health Psychology and Journal of the American Medical Association

Data collection and analysis

Selection of studies

Inclusion criteria was applied to all titles and, where available, abstracts identified from the literature search by two review authors. Potentially relevant references was then retrieve for further screening by one review author and check by a second. Any disagreement was resolved through discussion with recourse to a third review author when necessary.

Data extraction and management

The following data were extracted:

- Author and year of publication
- Country, town, Setting
- study design
- Total number of intervention groups
- Unit of data analysis
- Sample size calculation
- Duration of follow-up
- total number enrolled
- Eligible participants
- age
- ethnicity
- Intervention details: type of intervention, description of intervention, frequency and duration of intervention
- comparator group(s)
- Outcomes measures

Assessment of risk of bias in included studies

Risk of bias assessed in included studies using the Cochrane Collaboration's Risk of Bias tool (Higgins 2011). The tool includes the following domains: random sequence generation; allocation concealment; blinding of participants and personnel; blinding of outcome assessment; incomplete outcome data; selective reporting; and other sources of bias. Any disagreement will be resolved by consensus, by consulting a third author.

Measures of treatment effect

We used only dichotomous outcomes we used the odds ratio and its 95% CI was calculated.

Unit of analysis issues

The unit of analysis was individuals. After adjustment for possible confounding, data derived from cluster-randomized controlled trials produced same results. We included cluster-randomized trials in the meta-analysis along with individually-randomized trials. We adjusted for design effect using an 'approximation method' (Higgins 2011).

Dealing with missing data

We did not experience any missing data in this systematic review

Assessment of heterogeneity

Heterogeneity between trials was assessed by visual inspection of forest plots, by estimation of the percentage of I^2 between trials which could be ascribed to sampling variation (Higgins 2011), by a formal statistical test of the significance of the heterogeneity (Deeks 2001) and, if possible, by sub-group analyses. If we find substantial heterogeneity, the possible reasons for this was investigated and reported.

Assessment of reporting biases

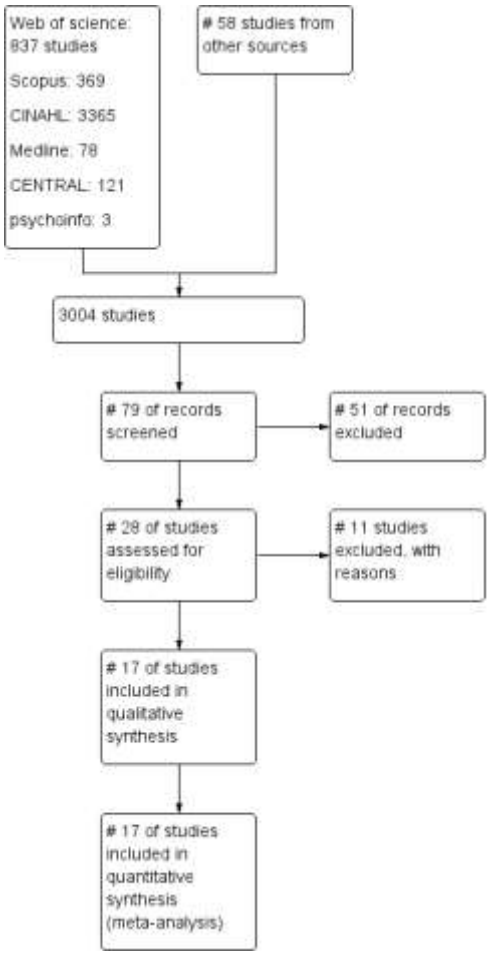
Funnel plots corresponding to meta-analysis of the primary outcome was examined if we have 10 or more studies. We then assessed the potential for small study effects. If there is evidence of small-study effects, publication bias was considered as only one of a number of possible explanations. If these plots suggested that treatment effects may not be sampled from a symmetric distribution, as assumed by the random effects model, sensitivity analyses was carried out using fixed effects models.

Data synthesis

Data synthesis was based on the heterogeneity of the studies. When heterogeneity was not too large, we performed a meta-analysis. In the presence of homogeneity, we used a fixed-effect model for the meta-analysis. In the case of moderate or high heterogeneity, we used a random-effects model to produce the overall results.

Results

Results of the search



Included studies

Seventeen studies were included in this systematic review (see annex table 1: Characteristics of included studies). Twelve RCTs (Abdul 2013; Broberg 2013; Buehler 1997; Dietrich 2006; Heranney 2011; Jibaja-Weiss 2003; Lantz 1995; Miller 1997; Miller 2013; Radde 2016; Robinson 2010; Torres-Mejia 2000), two cluster randomized control trials (Abdullah 2013; Beach 2007), two quasi-randomized control trial (de Jonge 2008; Lima 2017) and one non randomized control trial (Tavasoli 2016).

Excluded studies

Ten studies were excluded from the review among which (Bergmeir 2012; Catarino 2015; Del 2017; Eichhorn 2005; Giorgi 2015; Kobetz 2017; Quinley 2011; Ricard-Gauthier 2015; Sherman 2007; Yabroff 2011) (see annex table 2: Characteristics of excluded studies)

Risk of bias in included studies

Allocation (selection bias)

Allocation concealment was minimized in Abdul 2013; Abdullah 2013; Dietrich 2006; Lima 2017; Miller 1997; Miller 2013; Radde 2016. In Beach 2007; Buehler 1997; Heranney 2011; Jibaja-Weiss 2003; Lantz 1995; Robinson 2010, selection bias was unclear, therefore high in Broberg 2013; de Jonge 2008; Tavasoli 2016; Torres-Mejia 2000

Blinding (performance bias and detection bias)

Bias assessment stool revealed that performance bias was reduced in Abdul 2013; Abdullah 2013; Lima 2017; Jibaja-Weiss 2003; Torres-Mejia 2000 . unclear Beach 2007; Buehler 1997; de Jonge 2008; Dietrich 2006; Heranney 2011; Lantz 1995; Miller 1997; Miller 2013; Radde 2016; Robinson 2010; Tavasoli 2016 and high Broberg 2013

Incomplete outcome data (attrition bias)

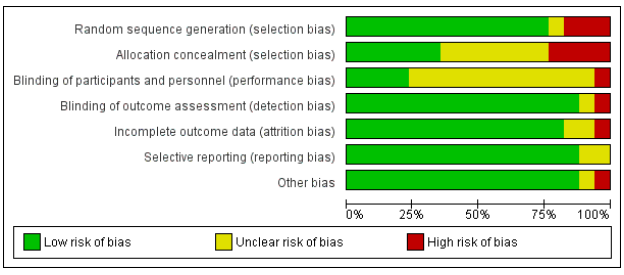
We found that incomplete outcome data(attrition bias) Abdul 2013 Abdullah 2013; Broberg 2013; Buehler 1997; de Jonge 2008; Heranney 2011; Jibaja-Weiss 2003; Lantz 1995; Lima 2017; Miller 1997; Radde 2016; Robinson 2010; Tavasoli 2016; Torres-Mejia 2000 were low risk of bias, Dietrich 2006; Miller 2013 were unclear and Beach 2007 was high.

Selective reporting (reporting bias)

Critical appraisal revealed that Abdul 2013; Broberg 2013; Buehler 1997; de Jonge 2008; Dietrich 2006; Heranney 2011; Jibaja-Weiss 2003; Lima 2017; Radde 2016; Tavasoli 2016 were low risk of bias. Therefore Lantz 1995; Miller 1997; Miller 2013; Robinson 2010; Torres-Mejia 2000 were unclear and Abdullah 2013; Beach 2007 were high risk of bias

Other potential sources of bias

We judged as low risk of bias Abdul 2013; Abdullah 2013; Buehler 1997; de Jonge 2008; Dietrich 2006; Jibaja-Weiss 2003; Lantz 1995; Lima 2017; Miller 1997; Miller 2013; Radde 2016; Robinson 2010; Tavasoli 2016; Torres-Mejia 2000 as unclear Beach 2007 and Broberg 2013; Heranney 2011 were judged as high risk of bias.



Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

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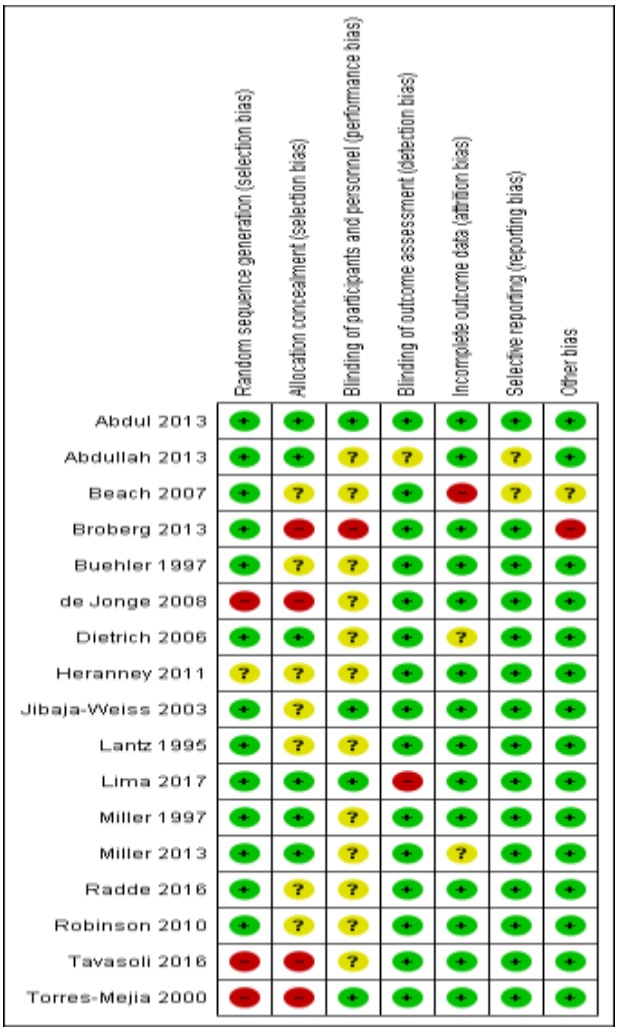
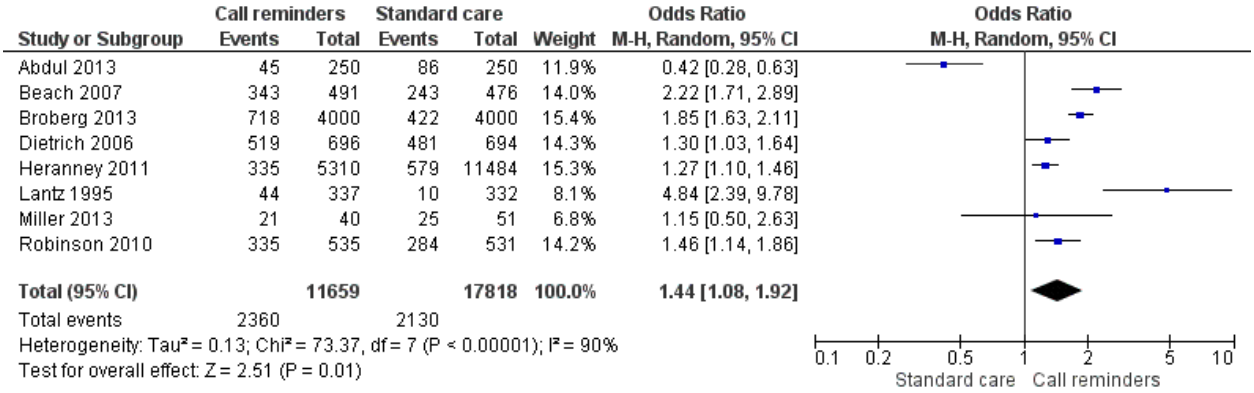


Risk of bias summary: review authors' judgements about each risk of bias item for each included study.

Summary of main results

Call reminders and cervical cancer screening

Height studies (Abdul 2013; Beach 2007; Broberg 2013; Dietrich 2006; Heranney 2011; Lantz 1995; Miller 2013; Robinson 2010) were included in the forest plot analyzing the effect of call reminders on cervical cancer screening in risk women. Call reminders were statistically significant in increasing cervical cancer screening compared to the standard care (OR 1.44 95% CI 1.08, 1.92, 29477 participants, 8 studies, Heterogeneity: $Tau^2 = 0.13$; $Chi^2 = 73.37$, df = 7 ($P < 0.00001$); $I^2 = 90\%$, random effects). Test for overall effect: Z = 2.51 (P = 0.01).



Forest plot of comparison: call reminders versus standard care, outcome: Pap smear testing.

Call reminders and adherence to cervical cancer screening

Three studies (Abdullah 2013; Lima 2017; Miller 1997) were included in examining the

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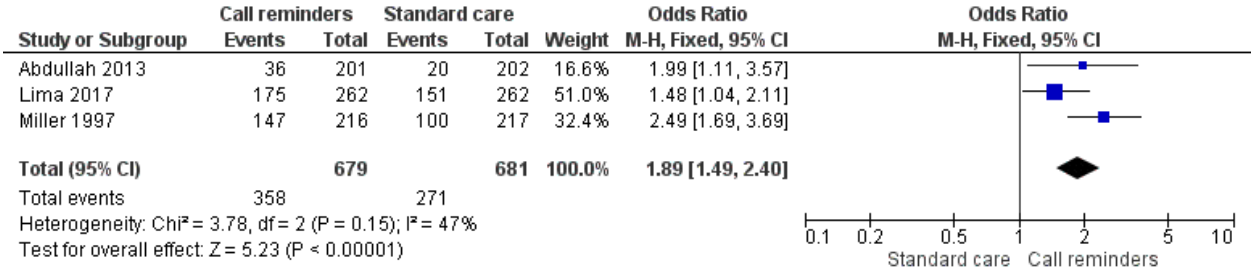
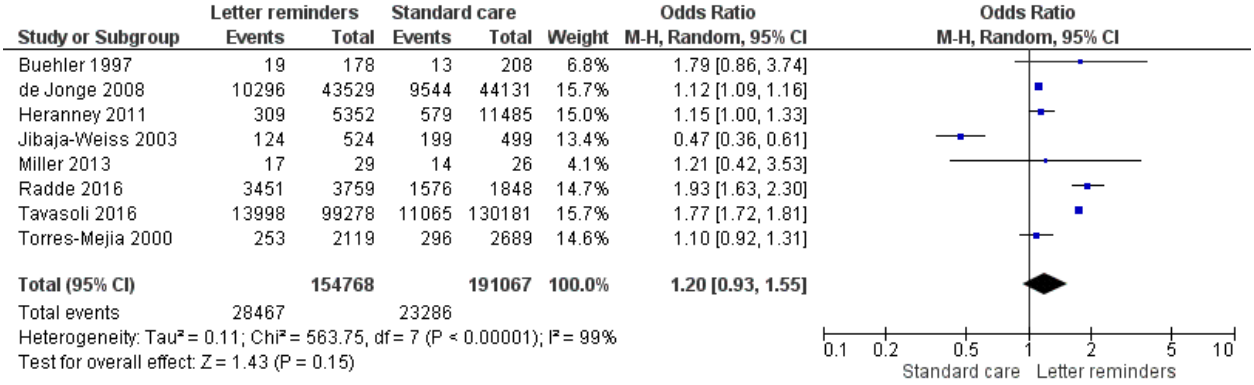
effect of call reminders on cervical cancer screening adherence. Call reminders versus standard care has shown statistically significant results (OR 1.89 95% CI 1.49, 2.40, 1360 participants, 3 studies).Heterogeneity: Chi² = 3.78, df = 2 (P = 0.15); I² = 47%, fixed effects). Test for overall effect: Z = 5.23 (P < 0.00001)



Forest plot of comparison: call reminders versus standard care, outcome: Adherence to cervical cancer screening.

Letter reminders and cervical cancer screening

Height studies were included in letters reminders versus standard care (Buehler 1997; Heranney 2011; Jibaja-Weiss 2003; Miller 2013; Radde 2016; Tavasoli 2016 Torres-Mejia 2000 ; de Jonge 2008). Letter reminders did not improve cervical cancer screening (OR 1.20 95% CI 0.93, 1.55, 345835 participants, 8 studies, Heterogeneity: Tau² = 0.11; Chi² = 563.75, df = 7 (P < 0.00001); I² = 99%, random effects). Test for overall effect: Z = 1.43 (P = 0.15).



Forest plot of comparison: letter reminders versus standard care, outcome: Pap smear testing.

SMS reminders and cervical cancer screening

One study analyzed the effect of SMS reminders on cervical cancer (Abdul 2013). SMS reminders increased cervical cancer screening (OR 1.19 95%CI 0.77 to 1.84, 500 participants, 1 study, test for heterogeneity not applicable, fixed effects).

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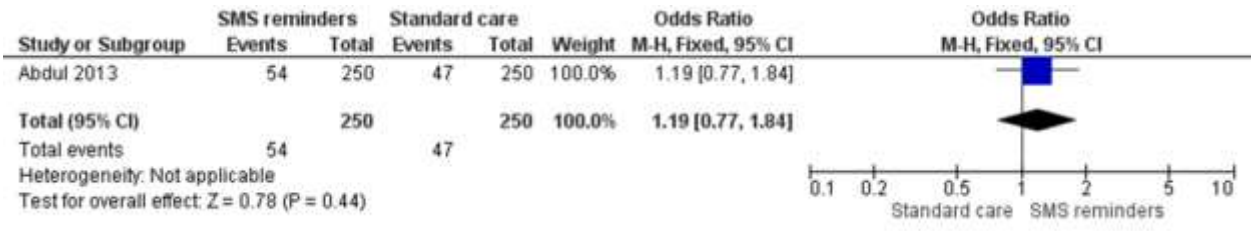
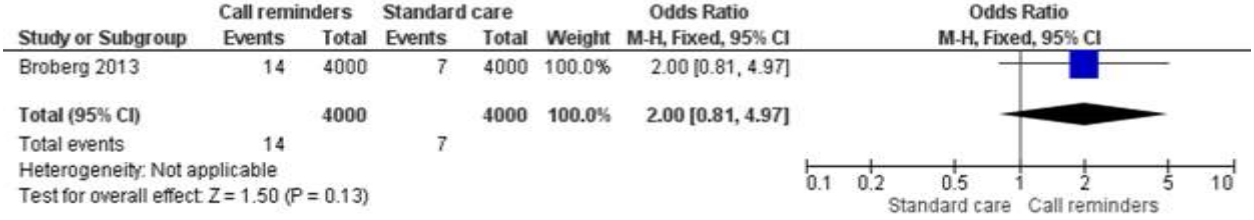


Forest plot of comparison: SMS reminders versus standard care, outcome: cervical cancer screening.

Call reminders and CN 2+

One study examined the effect of call reminders on diagnosing CN 2+ (Broberg 2013). The result has shown the call reminders improved CN 2+ diagnostic (OR 2.00 95% CI 0.81 to 4.97, 8000 participants, 1 study, test for heterogeneity not applicable, fixed effects).



Forest plot of comparison: call reminders versus standard care, outcome: CIN 2+.

Discussion

The overall completeness and applicability of evidence could be judged respectively high and moderate when we considered the impact of call reminders on adherence to screen cervical cancer and cervical cancer screening (see annex table 4). High evidence in adherence to screen cervical cancer could justify the strength of this review. This evidence is strengthened by a recent review that has shown automated telephone communication systems interventions can modify patients' health behaviors, improve clinical outcomes and increase healthcare uptake with positive effects in multiple health areas among which immunization, screening, appointment attendance, and adherence to medications or tests (Posadzki 2016). Letter reminders have shown to improve cervical cancer screening outcomes; therefore the results were not statistically significant compared to recent studies conducted in this field (Radde 2016; Tavasoli 2016). The quality of evidence was very low due to high heterogeneity between studies. Letter reminders could still constitute an option in improving cervical cancer screening; however, more randomized control trials are needful to strengthen this evidence.

This study could influence public health policy in improving adherence to screen cervical cancer screening in risk population. Therefore, several limitations should be

taken under considerations. The review included three studies design in the overall results (RCTs, non RCTs and quasi-RCTs), increasing highly heterogeneity between studies. Even though the sample size was large enough in cervical cancer screening outcome, the overall result was subject of imprecision.

We found only one RCT that investigated the effect of SMS on cervical cancer screening. The result was not significant. In addition, the quality of evidence was moderate. Further studies should be conducted in this field even if several reviews have shown positive effect of short messaging on health outcomes. Lastly, one RCT was included in the analysis mHealth on diagnosing cervical intraepithelial neoplasia grade 2. The quality of evidence was moderate; the overall result was not significant. Therefore, further studies are needful in this field.

Telephone interventions is a resource associated with the nursing practice, which can produce significant changes in the health outcomes, highlighting the importance of technical and clinical knowledge for the interventions by the professional (Lima 2017). Furthermore, the use of technology for healthcare development requires trained professionals to promote the convergence between human development and technological knowledge, aiming at the desired goals (Lima 2017). Reviewing the characteristics of included studies, most of them were conducted in Europe and America. External validity in Sub-Saharan Africa could be challenging as we did not found any study conducted in this setting.

The lack of high-quality evidence on the prevention of cervical cancer for high risk women, which is important for implementing efficient screening and treatment strategies, results then in the absence of a clearly defined health program in low and middle income countries (Viviano 2017). This is responsible for the low screening uptake and high mortality rates (Viviano 2017).

As said above, several knowledge gaps might inhibit women from undergoing cervical cancer screening. This review could be useful in overcoming certain gaps, and then cervical cancer screening could be ameliorated.

Authors' conclusions

Nowadays, the risk of developing cervical precancerous and cancerous lesions is high; therefore close monitoring and specific schedule for follow constitute a big challenge. This review supports the use of call reminders in improving cervical cancer screening and adherence to testing. Then, call reminders could be suggested to be incorporated in different national policy in screening cervical cancer in risk populations. The lack of sufficient evidence on the subject limits the reliability of the current cervical cancer screening guidelines for high risk women is the leading cause of diagnosing cervical cancer in the last stage. Further studies in this field will provide more solid foundations for preventing cervical cancer. However, this review could orientate public health policy makers.

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Declarations of interest

Authors did not have any conflict of interest.

Published notes

The protocol was accepted and published on prospero with citation: Tamuzi Lukenze Jacques, Jonathan Tshimwanga Lukusa, and Ley Muyaya Muyaya. Effectiveness of mHealth to increase cervical cancer screening: systematic of interventions. PROSPERO 2015:CRD42015026225 Available from http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD4201502622

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Annex tables

1. Characteristics of included studies

Abdul 2013

Methods	Prospective randomized controlled study
Participants	Women of Klang who attended cervical screening and had a normal Pap smear in the previous year, and were due for a repeat smear. The list of 1239 women aged 20-65 years, 1106 women were eligible for this study.
Interventions	The recall methods given to the women to remind them for a repeat smear were either by postal letter, registered letter, short message by phone (SMS) or phone call.
Outcomes	**repeat pap-smear** Letter: 47/250 Register letter: 50/250 Short message: 54/250 Phone call: 86/250
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Women had been randomly selected by computer-generated number...
Allocation concealment (selection bias)	Low risk	The patients who received any type of recall were given the same information that they will have to come for a repeat smear....
Blinding of participants and personnel (performance bias)	Low risk	All the research assistants were blinded to the intervention to prevent bias.
Blinding of outcome assessment	Low risk	Pap smear records

(detection bias)		
Incomplete outcome data (attrition bias)	Low risk	Intention to treat was used.
Selective reporting (reporting bias)	Low risk	....has been approved by National Medical Research Register (NMRR) (registration number NMRR- 10-111-7315).
Other bias	Low risk	The study seems to be free of other bias

Abdullah 2013

Methods	**cluster randomized controlled trial with parallel and un-blinded design**
Participants	The clusters were national secondary schools with 84 schools in Kuala Lumpur which divided into four zones with an average of 20 schools per zone. (20 schools with 201 participants), while the control group received usual care from the existing cervical screening program (20 schools with 202 participants). Multivariate logistic regression was performed to determine the effect of the intervention program on the action stage (Pap smear uptake) at 24 weeks.
Interventions	A call–recall program was introduced to the intervention group, which includes a personal invitation letter with an information pamphlet of cervical cancer screening, and followed by a telephone reminder with counseling after four weeks that was performed once per participant. The control group received usual care from the existing program.
Outcomes	**cervical screening behavior change was collected as main outcome**. Action (had a Pap test)(24 weeks): intervention group: 36/201 Control group: 20/202
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Using a computer generated simple randomization method in SPSSv15,
Allocation concealment (selection bias)	Low risk	Randomization was revealed after recruitment of the final school to ensure concealment of allocation
Blinding of participants and personnel (performance bias)	Unclear risk	Impossible to judge 'Yes' or 'No'
Blinding of outcome assessment (detection bias)	Unclear risk	A post-intervention questionnaire was administered at 24 weekswhere the information on stages of cervical screening behavior change was collected as main outcome
Incomplete outcome data (attrition bias)	Low risk	low lost of follow up
Selective reporting (reporting bias)	Unclear risk	Trial registration: This trial was registered at the Iranian Registry of Clinical Trials (IRCT) with registration number 201103186088N1.
Other bias	Low risk	free of other bias

Beach 2007

Methods	multisite randomized controlled trial
Participants	Women ages 50 to 69 years in New York City serve a primarily low-income and minority population. 491 among intervention group and 476 among control group.
Interventions	During the intervention, the PCM made periodic telephone calls to remind women about being overdue for targeted screenings. Each woman was followed by the PCM for 18 months after consent or until she was fully up-to-date, whichever came first. Women in the PCM intervention received an average of four calls during the intervention.

Outcomes	**cervical cancer** (Pap test within 18 months) Intervention group: 343/491 Control group: 273/476
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	...were produced by Dartmouth College staff with a computer-based random-number generator.
Allocation concealment (selection bias)	Unclear risk	....to receive the intervention or usual care by using sealed randomization forms
Blinding of participants and personnel (performance bias)	Unclear risk	Insufficient elements to imply 'Yes' or 'No'
Blinding of outcome assessment (detection bias)	Low risk	A review of medical records, completed 3 months after the end of the intervention to allow time for records to be updated, provided the data on screenings received during the baseline and intervention periods, which were used in the analysis.
Incomplete outcome data (attrition bias)	High risk	The proportion of missing outcomes compared with observed event risk enough to induce clinically relevant bias in intervention effect estimate.
Selective reporting (reporting bias)	Unclear risk	The study protocol is not available therefore, all pre-specified outcomes were assessed.
Other bias	Unclear risk	There are also limitations

Broberg 2013

Methods	randomized controlled trial
Participants	Women without a registered Pap smear in the two latest screening rounds.

	4,000 were randomized to a telephone call (reported previously). 4,000 constituted a control group (standard screening invitation routine).
Interventions	standard screening invitation routine standard routine plus a telephone call
Outcomes	**Pap smear(10 weeks)** Intervention group: 718/4000 Control group: 422/4000 CIN 2+ detected and eradicated Intervention group: 14/4000 Control group: 7/4000 CIN 2+ detected and eradicated Intervention group: 87/4000 Control group: 43/4000
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	SAS 9.2 Software, the Plan procedure, was used to select and randomize 8,800 women, in parallel groups with a 1:5:5 ratios...
Allocation concealment (selection bias)	High risk	After sampling, the kits were returned in another postage free envelope to the laboratory...
Blinding of participants and personnel (performance bias)	High risk	In the telephone arm, midwives at Antenatal Health Clinics attempted to contact 4,000 women and offer an appointment to take a Pap smear...
Blinding of outcome assessment	Low risk	Medical and laboratory records

(detection bias)		were used.
Incomplete outcome data (attrition bias)	Low risk	Intention to treat analysis was used.
Selective reporting (reporting bias)	Low risk	The study protocol is avalaible
Other bias	High risk	One limitation of this study was the small size of HPV arm...

Buehler 1997

Methods	Randomized controlled trial
Participants	A sample of 441 women aged 18–69 years 221 women in the intervention group 220 in the control group
Interventions	Personal letters of invitation and recall were sent on the letter head of the Provincial Cytology Registry and individually signed by the co-investigators. The letters were drafted by the investigators and adjusted for a grade 8 reading level. These drafts were reviewed by the Rabbittown Learners Group, a neighborhood literacy group, and revised accordingly. Letters were sent in January 1993, with reminder letters sent 4 weeks later. Women in the control group were not sent any letters.
Outcomes	**Proportion of women who had a Pap test** 2 months Intervention group:5/178 Control group: 4/208 6 months Intervention group:19/178 Control group: 13/208
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	...we randomly selected 650 using computer-generated numbers.
Allocation concealment (selection bias)	Unclear risk	Insufficient elements to imply 'Yes' or 'No'
Blinding of participants and personnel (performance bias)	Unclear risk	Insufficient information to judge 'Yes' or 'No'
Blinding of outcome assessment (detection bias)	Low risk	Clinical records were assessed
Incomplete outcome data (attrition bias)	Low risk	Intention to treat was used primary outcome analysis
Selective reporting (reporting bias)	Low risk	All outcomes were reported and the protocol is available
Other bias	Low risk	The study seems to be free of other bias

de Jonge 2008

Methods	Quasi-randomized trial
Participants	Women eligible for cervical cancer screening (from 25 to 64 years old): 43523 women in intervention and 44131 women in control group. Province of Limburg, Belgium
Interventions	Letter reminders
Outcomes	**Pap smear after 12 months:** Intervention group: 10296/43523 control group: 9544/44131
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Letters were posted for eight age specific units within a 5 year age group.
Allocation concealment (selection bias)	High risk	Allocation concealment is not present in quasi-randomized study design.
Blinding of participants and	Unclear risk	Not sufficient information de judge

personnel (performance bias)		'Yes' or 'No'
Blinding of outcome assessment (detection bias)	Low risk	Data were collected from pathology laboratories records.
Incomplete outcome data (attrition bias)	Low risk	Data were analyzed by intention to treat
Selective reporting (reporting bias)	Low risk	The protocol is not available therefore, author reported all outcomes
Other bias	Low risk	The study seems to be free of other bias

Dietrich 2006

Methods	Randomized Controlled Trial
Participants	1413 women who were overdue for cancer screening/ 11 community and migrant health centers in New York City Intervention group: 706 Control group: 707
Interventions	Over 18 months, women assigned to the intervention group received an average of 4 calls from prevention care managers and women assigned to the control group received usual care.
Outcomes	Pap smear testing(18 months) Intervention group: 519/696 Control group: 481/694
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	....were produced by Dartmouth College staff with a computer-based random-number generator.
Allocation concealment (selection bias)	Low risk	....to receive the intervention or usual care by using sealed randomization forms
Blinding of participants and	Unclear risk	Only clinicians, not care managers,

personnel (performance bias)		were responsible for ordering screenings at all but 2 centers
Blinding of outcome assessment (detection bias)	Low risk	Outcome data were based on reviews of patient medical records, which were conducted at least 3 months
Incomplete outcome data (attrition bias)	Unclear risk	Missing data outcome could introduce bias.
Selective reporting (reporting bias)	Low risk	Pre-specified outcomes were assessed.
Other bias	Low risk	The study seems to be free of bias

Heranney 2011

Methods	A Prospective Randomized Study
Participants	Randomized(Telephone group and Mail group) n = 10,662 Without a phone n = 11,484 Telephone group n = 5,310 Mail group n = 5,352
Interventions	One reminded by telephone, the other by mail.
Outcomes	Pap smear Telephone group Smear done n = 335 Mailing group Smear done n = 309 Without a phone Smear done n = 579
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not specific to judge 'Yes' or 'No'
Allocation concealment (selection bias)	Unclear risk	Not enough information to judge 'Yes' or 'No'

Blinding of participants and personnel (performance bias)	Unclear risk	This is difficult to judge 'Yes' or 'No'
Blinding of outcome assessment (detection bias)	Low risk	Outcome was assessed through medical records
Incomplete outcome data (attrition bias)	Low risk	Lost to follow up was minimized by using intention to treat
Selective reporting (reporting bias)	Low risk	The protocol was approved by the local institutional review board.
Other bias	Low risk	This study seems to be free of other bias

Jibaja-Weiss 2003

Methods	**Randomized control trial**
Participants	The sample included 1574 African–American, Mexican–American, and non-Hispanic white women, 18–64 years of age, who were registered as patients at two urban community health centers (CHCs) in Houston. Total eligible subjects (n =1483)
Interventions	development of prompting letters
Outcomes	(1) scheduling an appointment; (2) Receiving cancer-screening services within 12 months after study group assignment. **Scheduled screening:** Personalized tailored letter: 208 /524 Personalized form letter: 245/460 Control group: 223 /499 **Received screening** Personalized tailored letter: 124/524 Personalized form letter: 202/460 Control group: 199/499
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Using computer-generated random numbers, the subjects were assigned to each subgroup within one of the two intervention groups or the control group
Allocation concealment (selection bias)	Unclear risk	Not enought information to judge 'Yes' or 'No'
Blinding of participants and personnel (performance bias)	Low risk	The CHC clinical personnel were blinded to subject assignments.
Blinding of outcome assessment (detection bias)	Low risk	The outcome variables in this study were: (1) scheduling an appointment; and (2) receiving cancer-screening services within 12 months after study group assignment.
Incomplete outcome data (attrition bias)	Low risk	Lost to follow up seems to be minimized. In addition, intention to treat was used.
Selective reporting (reporting bias)	Low risk	The study protocol is available
Other bias	Low risk	The study seems to be free of other bias

Lantz 1995

Methods	Randomized control trials
Participants	female enrollees 40 to 79 years of age: Intervention Group(n=337) and Control Group (n = 322)
Interventions	Women in the control group received usual care. Women in the intervention group received a two-part intervention: First, each woman received a reminder letter from her primary care physician (or the medical director of the community health center if a primary physician could not be identified) based on which screening test(s) she needed. Second, women received a follow-up telephone call from a health educator (i.e., a nurse or social work intern) within 7 to 10 days after the letter was mailed;

Outcomes	Cervical Cancer Screening(pap smear) after 6 months Control group: 10/332 Intervention group: 44/337
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computerized medical claims data were...
Allocation concealment (selection bias)	Unclear risk	Not specified
Blinding of participants and personnel (performance bias)	Unclear risk	Not specified
Blinding of outcome assessment (detection bias)	Low risk	Outcome was assessed through medical claims database
Incomplete outcome data (attrition bias)	Low risk	Intention to treat was used
Selective reporting (reporting bias)	Low risk	all outcomes were reported
Other bias	Low risk	The study appears to free of other bias.

Lima 2017

Methods	quasi-experimental study with pre-test and post-test design
Participants	524 women, selected with the following inclusion criteria: be aged between 25 and 64 years, have initiated sexual activity, have inappropriate periodicity of examination and have mobile or landline phone. With 262 women for each group. Study done in the city of Fortaleza
Interventions	Group 1. Educational telephone intervention: an educational telephone intervention and the scheduling of the colpocytological examination were offered to the women. Group 2. Behavioral telephone intervention: a behavioral telephone intervention (telephone reminder) and the scheduling of the colpocytological examination were offered to the women.

Outcomes	Adherence to colpocytological examination Behavioral group: 175/262 Educational group: 151/ 262
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	The random selection was performed by means of a table created by using random allocation software.
Allocation concealment (selection bias)	Low risk	...was inserted into an opaque envelope, which was numbered and sealed.
Blinding of participants and personnel (performance bias)	Low risk	...women who were part of the sample were blinded with respect to the group to which they belonged. These trained professionals were also blinded..
Blinding of outcome assessment (detection bias)	High risk	The assessment was done though a questionnaire
Incomplete outcome data (attrition bias)	Low risk	lost to follow up was minimized in this study
Selective reporting (reporting bias)	Low risk	All outcome were reported
Other bias	Low risk	This study seems to free of type of bias

Miller 1997

Methods	randomized control trial design
Participants	The 828 participants ranged in age from 14 to 54 years
Interventions	Telephone appointment confirmation/reminder call. The telephone counseling. Attempts to reach the patient were made during both day and evening hours; patients were called up to a maximum of 10 times.
Outcomes	Adherence to Repeat (6-Month) Colposcopy

	Appointment Intervention group: 147/216 Control group: 109 / 217 Telephone counseling: 300/395
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Eligible patients were randomly assigned by use of a random numbers table to one of the four conditions prior to the initial...
Allocation concealment (selection bias)	Low risk	A health educator then attempted to contact patients in the three intervention groups by telephone in the week prior to their scheduled visit.
Blinding of participants and personnel (performance bias)	Unclear risk	The open-ended format used in that study was modified so that patients were systematically asked about the presence or absence of all potential barriers.
Blinding of outcome assessment (detection bias)	Low risk	Data from clinics were combined for analysis
Incomplete outcome data (attrition bias)	Low risk	Lost to follow up was minimized
Selective reporting (reporting bias)	Low risk	all outcomes are reported
Other bias	Low risk	This study seems to be free of other bias

Miller 2013

Methods	**Randomized control trials**
Participants	Low-income African–American and Latino women/ Care Center Colposcopy Clinic in North Philadelphia, Pennsylvania. n=210

	Enhanced Standart care(n=73) Tailored print intervention(n=76) Tailored Telephone intervention(n=61)
Interventions	(1) a telephone reminder that included an assessment of barriers to adherence, as well as counseling tailored to the barriers elicited. (2) telephone reminder and barriers assessment, followed by a mailed home tailored barriers print brochure. (3) enhanced standard care comprising telephone reminder and barriers assessment. Assessments were obtained at initial contact and 1-week later, as well as at 6- and 12- months after the initial colposcopy.
Outcomes	**Pap tests at 6- and 12-months** 6 months follow up Enhanced standard care: 25/51 Tailored print : 20/40 Tailored telephone : 21/30 12 months follow up Enhanced standard care: 14/26 Tailored print: 17/29 Tailored telephone : 17/27
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	...via a computerized randomization algorithm.
Allocation concealment (selection bias)	Low risk	....the interviewers followed scripted questions/prompts that were displayed on the computer screen and participants' responses were immediately entered into the database.

Blinding of participants and personnel (performance bias)	Unclear risk	Insufficient information to imply 'Yes' or 'No'
Blinding of outcome assessment (detection bias)	Low risk	Outcomes assessed by both medical chart reviews and self-report at 9- and 15-months post-initial colposcopy to allow for data collection for the 6- and 12-month follow ups.
Incomplete outcome data (attrition bias)	Unclear risk	....because of these missing data, we had to rely in some cases on self-report data, which can be subject to retrospective recall biases.
Selective reporting (reporting bias)	Low risk	The study protocol is available
Other bias	Low risk	The study seems to be free of other bias

Radde 2016

Methods	**randomized population-based cohort study**
Participants	Of the 7,758 eligible women aged 30–65 years, living in the city of Mainz and in the rural region of Mainz-Bingen, 5,265 were included in the analysis. Intervention group (Arm A): 1911 participants, Intervention group (Arm B): 1848 participants; Control group (Arm C): 1506 participants
Interventions	Intervention Arm A (invitation letter) and Arm B (invitation letter and information brochure) or control Arm C (no invitation). For Arm A, this letter included a study information sheet, a study identification card to show when visiting the office based gynecologist and a response card with pre-paid postage for the woman to give information to the study team concerning hysterectomy, pregnancy and last participation in cervical cancer screening. Arm B received the same material as Arm A, with an additional eight-page color brochure including information on cervical cancer and its precursor lesions, HPV infection, the process of Pap smear screening and simple explanations of relevant medical

	terminology. Women in the control group (Arm C) did not receive an invitation.
Outcomes	**Cervical cancer screening** intervention group: 3451/3759 control group: 1576 /1848
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomized into intervention groups Arm A and Arm B (both Module 1, intervention group) or into control Arm C (Module 3, control group) (Supporting Information Fig. 1) using the statistical software SAS...
Allocation concealment (selection bias)	Unclear risk	Impossible to judge 'Yes' or 'No'
Blinding of participants and personnel (performance bias)	Unclear risk	Difficult to say 'Yes' or 'No'
Blinding of outcome assessment (detection bias)	Low risk	The gynecologist also completed additional documentation, providing information about the patient.
Incomplete outcome data (attrition bias)	Low risk	Attrition was minimized in this study
Selective reporting (reporting bias)	Low risk	All outcomes were assessed.
Other bias	Low risk	This study seems to be free of other bias

Robinson 2010

Methods	**Randomized control trials**
Participants	Women of 50 to 69 years. 535 women in intervention group and 531 women in control group/ New York City
Interventions	Telephone calls and mailings were conducted in the woman's primary language (English or Spanish). While telephone calls were guided by a script, the content and length of conversations, as well as the frequency of calls,

	were tailored to the needs of each subject. Some women received a single call, while others presented substantial and persistent barriers, and in some cases received up to 20 calls. In addition to telephone support, PCMs also carried out various administrative tasks on behalf of women: PCMs prepared and mailed women Provider Recommendation Letters and Patient Activation Cards listing overdue screenings, to bring to their next primary care appointment; they also scheduled appointments, and informed and reminded patients by phone and by mail about these appointments.
Outcomes	**Pap testing within 18 months** Intervention group: 335/535 Control group: 284/531
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Women were grouped by age and C/MHC, and randomly assigned...
Allocation concealment (selection bias)	Unclear risk	Not sufficient information to judge 'Yes' or 'No'
Blinding of participants and personnel (performance bias)	Unclear risk	Not provided in this study
Blinding of outcome assessment (detection bias)	Low risk	Outcomes were assessed through medical records
Incomplete outcome data (attrition bias)	Low risk	Authors used intention to treat.
Selective reporting (reporting bias)	Low risk	The protocol is available and author reported all outcomes
Other bias	Low risk	The study seems to be free of other bias

Tavasoli 2016

Methods	**Non randomized control trial**

Participants	A cohort design was used to compare the impact of invitation and reminder letters on Pap uptake comparing women who received the intervention (n=99,278) with a historical non-intervention group (n=130,181). Between November 2013 and April 2014, all Ontario women 30 to 69 years of age, eligible for screening were invited for a cervical screening test
Interventions	The intervention was an invitation letter that also provided information about cervical cancer screening. A reminder letter was also sent 4 months after the initial invitation letter to women who did not get a Pap at this point.
Outcomes	Pap-smear 9 months Intervention group: 13998/99278 Intervention group: 11065/130181
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	This is a non- randomized control trial, sequence generation was not conducted
Allocation concealment (selection bias)	High risk	Allocation is not conducted in this study design
Blinding of participants and personnel (performance bias)	Unclear risk	Difficult to judge 'Yes' or 'No'
Blinding of outcome assessment (detection bias)	Low risk	The outcome was assessed through medical records
Incomplete outcome data (attrition bias)	Low risk	An intention-to-treat approach was used to measure the impact of the intervention
Selective reporting (reporting bias)	Low risk	The study is available
Other bias	Low risk	This study seems to be free of other type of bias.

Torres-Mejia 2000

Methods	**Randomized field trial**

Participants	A sample of 4,802 women, 20 to 64 years old, chosen at random from the Mexican Social Security Institute Register.
Interventions	The intervention consisted in mailing a registered letter to 2,419 women. All letters were printed in 1 computer using the mail merge of Word. Two nurses who were supervised by 1 of the authors delivered them in the same post office. The letter had a brief description of the importance and benefits of a Papanicolaou test, as well as a personalized invitation to take the test within 5 weeks following their receipt of the letter. On the back of the letter, there was a simple 5-item questionnaire to be answered and returned by those women who decided not to have the test (the letter included a pre-paid return envelope). The questionnaire referred to reasons for not wanting to take the test.
Outcomes	**Pap-smear** Intervention group: 253/2119 Control group: 296/2683
Notes	

Risk of bias table

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	The clinics were allocated into three strata: urban, suburban and rural. Four to 5 clinics were randomly selected from each stratum and one or two family physicians were randomly selected from each clinic.
Allocation concealment (selection bias)	High risk	Women were systematically assigned to intervention or control group.
Blinding of participants and personnel (performance bias)	Low risk	personnel who recorded information were blinded
Blinding of outcome assessment (detection bias)	Low risk	Outcome was assessed through medical records
Incomplete outcome data (attrition bias)	Low risk	Lost to follow up was minimized according to the Hazard function of pap smear test attendance.

Selective reporting (reporting bias)	Low risk	The study protocol is available. In addition, authors reported all outcomes.
Other bias	Low risk	The study seems to be free of other bias. Furthermore, contamination was avoided.

2. Characteristic of exclusion studies

Bergmeir 2012

Reason for exclusion	Web-based software framework was used to diagnose cervical cancer through microscopic images.

Catarino 2015

Reason for exclusion	The intervention smartphone was used to visualize the image

Del2017

Reason for exclusion	Outcomes were different than those assessed in this review

Eichhorn 2005

Reason for exclusion	A feasibility study.

Giorgi 2015

Reason for exclusion	Different outcomes and interventions that those included in this study

Kobetz 2017

Reason for exclusion	Outcomes were different than pre-specified outcomes

Quinley 2011

Reason for exclusion	The images for remote evaluation were taken with a mobile phone and transmitted by MMS.

Ricard-Gauthier 2015

Reason for exclusion	Image form smartphone was used to screen cervical cancer

Sherman 2007

Reason for exclusion	Web-based assessment diagnosing cervical cancer based on images.

Tranberg 2016a

Reason for exclusion	The outcomes were different

Yabroff 2011

Reason for exclusion	The study design was a national survey

3. Characteristics of ongoing studies

Tranberg 2016

Study name	Study protocol of the CHOiCE trial: a three-armed, randomized, controlled trial of home-based HPV self-sampling for non-participants in an organized cervical cancer screening program.

Methods	a parallel, randomized, controlled, open-label trial.
Participants	327 women aged 30-64 years who are living in the Central Denmark Region
Interventions	The women will be equally randomized into three arms: 1) Directly mailed a second reminder including a HPV self-sampling kit; 2) Mailed a second reminder offering a HPV self-sampling kit, to be ordered by e-mail, text message, phone, or through a webpage; and 3) Mailed a second reminder for a practitioner-collected sample (control group).
Outcomes	Proportion of women in the intervention groups who participate by returning their HPV self-sampling kit or have a practitioner-collected sample compared with the proportion of women who have a practitioner-collected sample in the control group at 90 and 180 days after mail out of the second reminders. The secondary outcome will be the proportion of women with a positive HPV self-collected sample who attend follow-up testing at 30, 60, or 90 days after mail out of the results.
Starting date	10 February 2016.
Contact information	Phone: (+45) 784 20 264, Email: mittrani@rm.kd
Notes	

4. Table of findings

mHealth for Cervical cancer screening

Patient or population: patients with Cervical cancer screening
Settings: Denmark, Mexico, Canada, US, Belgium, Malasia, Pakistan
Intervention: mHealth

Outcomes	Illustrative comparative risks* (95% CI) Assumed risk Control	Corresponding risk MHealth	Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
Pap smear testing	Study population		OR 1.44 (1.08 to 1.92)	29477 (8 studies)	⊕⊕⊕⊖ moderate[1]	
	120 per 1000	164 per 1000 (128 to 207)				
	Moderate					
	417 per 1000	507 per 1000 (436 to 579)				
Adherence to cervical cancer screening	Study population		OR 1.89 (1.49 to 2.4)	1360 (3 studies)	⊕⊕⊕⊕ high	
	398 per 1000	555 per 1000 (496 to 613)				
	Moderate					
	461 per 1000	618 per 1000 (560 to 672)				
Pap smear testing	Study population		OR 1.2 (0.93 to 1.55)	345835 (8 studies)	⊕⊖⊖⊖ very low[2,3,4]	
	122 per 1000	143 per 1000 (114 to 177)				
	Moderate					
	163 per 1000	189 per 1000 (153 to 232)				
Cervical cancer screening	Study population		OR 1.19 (0.77 to 1.84)	500 (1 study)	⊕⊕⊕⊖ moderate[5]	
	188 per 1000	216 per 1000 (151 to 299)				
	Moderate					
	188 per 1000	216 per 1000 (151 to 299)				
CIN 2+	Study population		OR 2 (0.81 to 4.97)	8000 (1 study)	⊕⊕⊕⊖ moderate[6]	
	2 per 1000	3 per 1000 (1 to 9)				
	Moderate					
	2 per 1000	4 per 1000 (2 to 10)				

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval; **OR:** Odds ratio;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1] Heterogeneity was above 75%
[2] Non randomized and quasi-randomized studies were included
[3] Hetogeneity was very high among included studies
[4] The 95% CI included the null value
[5] The 95%CI included 1
[6] Large 95%CI which icluded the null value