# Mobile phone messaging reminders for attendance at healthcare appointments (Review)

Car J, Gurol-Urganci I, de Jongh T, Vodopivec-Jamsek V, Atun R


This is a reprint of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in *The Cochrane Library* 2012, Issue 7

http://www.thecochranelibrary.com

WILEY

## TABLE OF CONTENTS

[Intervention Review]

# Mobile phone messaging reminders for attendance at healthcare appointments

Josip Car[1,2], Ipek Gurol-Urganci[3], Thyra de Jongh[4], Vlasta Vodopivec-Jamsek[2], Rifat Atun[5]

[1]Global eHealth Unit, Department of Primary Care and Public Health, School of Public Health, Imperial College London, London, UK. [2]Department of Family Medicine, Faculty of Medicine, University of Ljubljana, Ljubljana, Slovenia. [3]Health Services Research and Policy, London School of Hygiene and Tropical Medicine, London, UK. [4]Gephyra IHC, Amsterdam, Netherlands. [5]Imperial College Business School, Imperial College London, London, UK

Contact address: Josip Car, josip.car@imperial.ac.uk.

**Editorial group:** Cochrane Consumers and Communication Group.
**Publication status and date:** New, published in Issue 7, 2012.
**Review content assessed as up-to-date:** 12 May 2011.

**Citation:** Car J, Gurol-Urganci I, de Jongh T, Vodopivec-Jamsek V, Atun R. Mobile phone messaging reminders for attendance at healthcare appointments. *Cochrane Database of Systematic Reviews* 2012, Issue 7. Art. No.: CD007458. DOI: 10.1002/14651858.CD007458.pub2.



## ABSTRACT

### Background

Missed appointments are a major cause of inefficiency in healthcare delivery, with substantial monetary costs for the health system, leading to delays in diagnosis and appropriate treatment. Patients' forgetfulness is one of the main reasons for missed appointments, and reminders may help alleviate this problem. Modes of communicating reminders for appointments to patients include face-to-face communication, postal messages, calls to landlines or mobile phones, and mobile phone messaging. Mobile phone messaging applications such as Short Message Service (SMS) and Multimedia Message Service (MMS) could provide an important, inexpensive delivery medium for reminders for healthcare appointments.

### Objectives

To assess the effects of mobile phone messaging reminders for attendance at healthcare appointments. Secondary objectives include assessment of patients' and healthcare providers' evaluation of the intervention; costs; and possible risks and harms associated with the intervention.

### Search methods

We searched the Cochrane Central Register of Controlled Trials (CENTRAL, *The Cochrane Library* 2009, Issue 2), MEDLINE (OvidSP) (January 1993 to June 2009), EMBASE (OvidSP) (January 1993 to June 2009), PsycINFO (OvidSP) (January 1993 to June 2009), CINAHL (EbscoHOST) (January 1993 to June 2009), LILACS (January 1993 to June 2009) and African Health Anthology (January 1993 to June 2009). We also reviewed grey literature (including trial registers) and reference lists of articles.

### Selection criteria

We included randomised controlled trials (RCTs), quasi-randomised controlled trials (QRCTs), controlled before-after (CBA) studies, or interrupted time series (ITS) studies with at least three time points before and after the intervention. We included studies assessing mobile phone messaging as reminders for healthcare appointments. We only included studies in which it was possible to assess effects of mobile phone messaging independent of other technologies or interventions.

**Data collection and analysis**

Two review authors independently assessed all studies against the inclusion criteria, with any disagreements resolved by a third review author. Study design features, characteristics of target populations, interventions and controls, and results data were extracted by two review authors and confirmed by a third author. Primary outcomes of interest were rate of attendance at healthcare appointments. We also considered health outcomes as a result of the intervention, patients' and providers' evaluation of the intervention, perceptions of safety, costs, and potential harms or adverse effects. As the intervention characteristics and outcome measures were similar across included studies, we conducted a meta-analysis to estimate an overall effect size.

**Main results**

We included four randomised controlled trials involving 3547 participants. Three studies with moderate quality evidence showed that mobile text message reminders improved the rate of attendance at healthcare appointments compared to no reminders (risk ratio (RR) 1.10 (95% confidence interval (CI) 1.03 to 1.17)). One low quality study reported that mobile text message reminders with postal reminders, compared to postal reminders, improved rate of attendance at healthcare appointments (RR 1.10 (95% CI 1.02 to 1.19)). However, two studies with moderate quality of evidence showed that mobile phone text message reminders and phone call reminders had a similar impact on healthcare attendance (RR 0.99 (95% CI 0.95 to 1.03). The costs per attendance of mobile phone text message reminders were shown to be lower compared to phone call reminders. None of the included studies reported outcomes related to harms or adverse effects of the intervention, nor health outcomes or user perception of safety related to the intervention.

**Authors' conclusions**

There is moderate quality evidence that mobile phone text message reminders are more effective than no reminders, and low quality evidence that text message reminders with postal reminders are more effective than postal reminders alone. Further, according to the moderate quality evidence we found, mobile phone text message reminders are as effective as phone call reminders. Overall, there is limited evidence on the effects of mobile phone text message reminders for appointment attendance, and further high-quality research is required to draw more robust conclusions.

## PLAIN LANGUAGE SUMMARY

**Mobile phone messaging reminders for attendance at healthcare appointments**

Failure to attend healthcare appointments has a significant impact not only on the health of the patients but also on health system costs. This review studied whether sending patients appointment reminders using mobile phone text messaging (Short Message Service (SMS) and Multimedia Message Service (MMS)) could improve attendance. Low to moderate quality evidence included in this review shows that mobile phone text messaging reminders increase attendance at healthcare appointments compared to no reminders, and postal reminders, and had the same impact as phone call reminders. The costs per attendance of mobile phone text message reminders are lower compared to phone call reminders. None of the included studies reported on harms or adverse effects of the text messaging reminders, nor on health outcomes or people's perceptions of safety related to receiving reminders by text message.There is a need for more research assessing the effects of mobile phone messaging reminders for attendance at healthcare appointments.

## SUMMARY OF FINDINGS FOR THE MAIN COMPARISON *[Explanation]*

**Patient or population:** patients with healthcare appointments
**Settings:** all settings (primary, hospital, community, outpatient)
**Intervention:** Mobile phone text message reminders
**Comparison:** No reminders

| Outcomes | Illustrative comparative risks* (95% CI) | | Relative effect (95% CI) | No of Participants (studies) | Quality of the evidence (GRADE) |
|---|---|---|---|---|---|
| | Assumed risk | Corresponding risk | | | |
| | No reminders | Mobile phone text message reminders | | | |
| Attendance rate at healthcare appointments | 717 per 1000 | 793 per 1000 (738 to 839) | RR 1.1 (1.03 to 1.17) | 2313 (3 studies) | ⊕⊕⊕◯ **moderate**[1,2] |
| Other outcomes | None of the included studies reported on health outcomes, user evaluation of the intervention, user perception of safety, costs, potential harms or adverse events of the intervention | | | | |

*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; **RR:** Risk 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] Unclear risk of bias for several categories in the included studies.
[2] In one study the unit of analysis was appointment rather than individual participant which may have resulted in clustering of data.

## BACKGROUND

Mobile phone messaging is an important means of human communication globally. Mobile phone penetration is rapidly increasing particularly in the Asia-Pacific region, with 90% of the global and 80% of rural population having access to a mobile network in 2010. The number of subscriptions in 2010 reached 5.3 billion, representing a 76.2% global penetration rate (ITU 2010). The penetration rates are 70% to 90% in high-income countries, with a similar rate of increase across all socio-economic groups (Atun 2006).

Most digital mobile phones provide Short Message Service (SMS), also known as text messaging, and Multimedia Message Service (MMS) for transmitting graphics, video clips and sound files. SMS, in particular, has rapidly developed into a powerful communication medium, particularly among young adults. The total number of text messages sent globally tripled between 2007 and 2010, from an estimated 1.8 trillion to 6.1 trillion, with about 200,000 messages sent every second (ITU 2010).These short messages, where up to 160 characters of text are sent from the Internet or from a mobile phone to one or several mobile phones, could provide an important, inexpensive delivery medium of communication. The terms text message, text, or txt are more commonly used in North America, the UK, Spain and the Philippines, while in many other countries the term SMS is used. In this review we will use the term 'text messaging' to refer to the use of SMS only, distinguishing it from the term 'mobile phone messaging', which encompasses both SMS and MMS. Increasingly, the latter term also refers to mobile email and 'instant messaging' delivered to the mobile phone.

Text messages, compared to other communication channels, have the advantage of instant transmission and low cost. There is also a smaller chance of being misplaced compared to print materials, and of being invasive to daily lives compared to phone calls (Kaplan 2006). Features such as ubiquity, mobility, direct and instantaneous access and direct communication offer the possibility of using mobile phones for health information transfer (Atun 2006). A literature review on the use of mobile phones in health care has demonstrated the wide application and potential of mobile phones to: increase access to health care; enhance efficiency of service delivery; improve diagnosis, treatment and rehabilitation; and support public health programmes (Atun 2006; Car 2008). Mobile phone messaging has, for example, been used to provide appointment reminders (Bos 2005), to improve patient compliance with medications (Fairley 2003; Marquez Contreras 2004; Vilella 2004), to monitor chronic conditions (Ferrer-Roca 2004; Kwon 2004; Ostojic 2005) and to provide psychological support (Bauer 2003; Franklin 2003). Mobile phones have also been used in managing communicable diseases (e.g. in contact tracing and partner notification for sexually transmitted illnesses (Newell 2001)) and in health promotion programmes (e.g. in smoking cessation (Obermayer 2004; Rodgers 2005)). Furthermore, the use of mobile phones has been shown to improve service utilization among population groups such as teenagers and young adult males who do not typically use health services, by providing the opportunity to remotely access care providers for advice (Atun 2006b). However, for older adults, some of whom are less able or willing to use mobile phones, the effect on improved service utilization could be limited (Atun 2006b).

Challenges in using mobile phone applications in health care include incomplete coverage of mobile networks across regions, lack of standards, and possible information overload (Adler 2007).

This review is part of a series of four reviews which aim to determine the effects of mobile phone messaging in improving the processes of healthcare service delivery and service utilization.

We divided the reviews into four areas based on the specific interventions and related outcomes:

- Mobile phone messaging reminders for attendance at healthcare appointments (this review);
- Mobile phone messaging for communicating results of medical investigations (Gurol-Urganci 2012);
- Mobile phone messaging for preventive health care (Vodopivec-Jamsek 2012 (in press));
- Mobile phone messaging for facilitating self-management of long-term illnesses (de Jongh 2012 (in press)).

### Description of the condition

Missed appointments are a major cause of inefficiency in healthcare delivery, with substantial monetary costs for health systems; and delays in diagnosis and appropriate treatment for the non-attending patient. In England's National Health System (NHS), over a one-year period the direct costs alone were 185 million UK pounds for GP appointments, 34 million UK pounds for practice nurse appointments and estimated to be around 575 million UK pounds for hospital appointments (DoH 2004; DPP 2003). Economic incentives, such as imposing a fine on non-attendees, could reduce non-attendance rates, and this strategy has been suggested in Denmark and the UK (Bech 2005).

A number of reviews have assessed the factors leading to missed appointments (Deyo 1980; George 2003; Sharp 2001), in a range of country settings, including Canada, Denmark, Finland, Hong Hong, New Zealand, Norway, Saudi Arabia, Scotland, Singapore, Spain, UK, and USA. Studies have found differences in the appointment keeping behaviour of patients by demographic factors, such as age and gender (Hon 2002; Mantyjarvi 1994; Moore 2001; Simmons 1997; Skaret 1998; Waller 2000), race and ethnicity (Clarke 1998; Gatrad 1997; Gatrad 2000); or socio-economic status, such as unemployment, perceived social support (Brown

1999; Catz 1999; Ramm 2001; Reekie 1998), lower levels of community functioning (Coodin 2004) and living in a deprived area (Neal 2001).

Detailed surveys among non-attendees and their healthcare providers identify the main patient-related factors for missing scheduled appointments as: health beliefs (Al Faris 2002; Mirotznik 1998); lack and difficulty of transportation (Campbell 2000; Collins 2003; Mohamed 2002; Paul 1997; Pesata 1999); scheduling problems (Campbell 2000; King 1995; Ross 1995); health status (Cashman 2004; Kane 1991; Killaspy 2000; Richardson 1998; van Baar 2006); resistance to consultation (Grunebaum 1996; Wogelius 2005); insurance status (Canizares 2002; Iben 2000; Majeroni 1996; Weingarten 1997; Yoon 2005); and frustration with outpatient clinic organisation resulting in long waiting times and discontinuity of care (van Baar 2006). Health system-related factors include: inadequate communication between healthcare providers and patients (Bottomley 1994; Lloyd 1993; Martin 2005), which are worsened by patients missing appointments (Husain-Gambles 2004); waiting times (Pesata 1999); quality of consultation; facilities in the waiting area (Chung 2004); time interval between scheduling/referrals and appointments (Grunebaum 1996; Hamilton 2002; Livianos-Aldana 1999); administrative and/or clerical problems (Hull 2002; Potamitis 1994); and site of care (Lasser 2005; Specht 2004).

One of the cited reasons for missing an appointment is simply that patients forget that they had an appointment (Hong Kong (Hon 2005); Scotland (Herrick 1994; Hull 2002); Saudi Arabia (Mohamed 2002); UK (Murdock 2002; Neal 2005; Pal 1998; Potamitis 1994); Northern Ireland (Richardson 1998); Norway (Skaret 2000); Malaysia (Zailinawati 2006); USA (Carrion 1993)). Any form of reminders may thus decrease the rate of missed appointments, reducing the inefficiencies and costs generated by non-attendance. Importantly, reminders give patients an opportunity to cancel an appointment either by a return mobile phone message or a phone call.

## Description of the intervention

We identified seven possible modes of communicating reminders for healthcare appointments to patients are face-to-face, postal message, call to landline, call to mobile, via web based electronic health records, email and SMS/MMS. In Table 1 we outline basic characteristics and a comparison of these modes of communication Table 1. Existing literature on appointment reminders focuses on postal messages, phone calls, emails and text reminders.

## How the intervention might work

Various communication channels such as phone calls, letters and text messages have been used for appointment reminders that aim to reduce missed appointments. A study conducted in a Dutch orthodontic clinic did not find evidence that reminders reduced failed attendance rates. When given the choice, patients in this study preferred mail reminders to telephone and text message reminders. Some patients were also negative about the usefulness of reminders (Bos 2005). A systematic review on prompts to encourage attendance for people with serious mental illness concluded that prompts close to the time of appointment may increase attendance and that a simple orientation letter would be more effective than a telephone prompt (Reda 2010). A study which compared postal, manual telephone and automated telephone reminders (or all three combined) in a general dental practice in the UK found that all reminder methods resulted in net cost savings, and that both postal and manual telephone techniques were effective in improving attendance rates (Reekie 1998).

Benefits of using phone call reminders have also been reported in RCTs in adolescent and public health clinic settings in Australia and USA (Dini 1995; Hashim 2001; Sawyer 2002). Benefits of using postal reminders have been reported in RCTs in orthodontic clinic settings in the UK (Can 2003; Thomas 2004).

There are studies of the impact of text message reminders on missed appointments in the NHS (Milne 2006), in Australia (Downer 2005; Downer 2006) and in Malaysia (Leong 2006), as well as reported applications in imaging diagnostics, dermatology and sexual health clinics in the UK; outpatient clinics in the USA and Norway; and private dental and chiropractic clinics in Sweden (Atun 2006; Dyer 2003).

### Acceptability and risks of the intervention

In some UK pilots, confidentiality issues surrounding text-messaging reminders have been addressed by an 'opt-out' scheme, or information leaflets have acted as consent forms (Atun 2006). Another concern regarding text-messaging reminders is their possible impact on health inequalities, as people in higher socio-economic groups, who are more likely to own a mobile phone, will be less likely to miss appointments (Fahey 2003). However, this concern may not be realised, given mobile phone ownership statistics and other unpublished studies regarding mobile phone use and socio-economic status (Ellenbogen 2003; Vernon 2003). Patients who receive text reminders may be more inclined to ignore other paper-based communication, which may also include key information (Vodafone 2004).

Possible disadvantages of using mobile phone messaging include the risk of inaccurate data input (Norwell 2003), lack of understanding or misinterpretation of the information, and difficulties in reading for those with poor vision or problems with literacy.

Having correct patient contact information and securely stored health records are essential to adhere to privacy, confidentiality and data protection requirements. Failures or delays in message delivery are rare but possible; however, harm is unlikely as senders are usually notified instantly in cases where there was a transmission problem. There may be additional monetary and time costs, as

backup systems may be needed. Lastly, risks associated with mobile phone messaging in general may apply, for instance increased risk of car accidents as a result of messaging whilst driving.

### Why it is important to do this review

Although there is some evidence on the use and effectiveness of mobile phones in healthcare delivery, answers to questions regarding the implementation of SMS technologies in routine care, such as their impact on patient-related outcomes or on the processes of healthcare delivery, are unclear. Given the topical nature of mobile phone messaging we conducted this review to identify answers to these questions and propose directions for future research. This review also complements available studies on use of telephone consultations (Car 2003), email (Car 2004; Car 2004b) and personal digital assistants (PDAs) (Baumgart 2005) in health care, and parallel Cochrane reviews on mobile phone messaging for a range of other purposes (de Jongh 2012 (in press); Gurol-Urganci 2012; Vodopivec-Jamsek 2012 (in press)), as well as a review on various reminder interventions for improving vaccination rates (Jacobson Vann 2005).

## OBJECTIVES

To assess the effects of mobile phone messaging reminders for attendance at healthcare appointments. Secondary objectives include assessment of patients' and healthcare providers' evaluation of the intervention; costs; and possible risks and harms associated with the intervention.

## METHODS

### Criteria for considering studies for this review

#### Types of studies

We included randomised controlled trials (RCTs), quasi-randomised controlled trials (QRCTs), controlled before and after studies (CBAs), and interrupted time series (ITS) with at least three time points before and after the intervention.

We define QRCT as a controlled trial in which participant allocation is not truly random, such as allocation by date of birth or the order in which participants are included in the study. We included QRCT, CBA and ITS designs, because our initial literature searching suggested that only a small number of RCTs on mobile phone messaging interventions exist.

#### Types of participants

We included all study participants regardless of age, gender and ethnicity, as well as all types and stages of diseases. We included studies in all settings, i.e. primary care settings (services of primary health care), outpatient settings (outpatient clinics), community settings (public health services) and hospital settings. We did not exclude studies according to the type of healthcare provider (e.g. nurse, doctor, allied staff).

#### Types of interventions

We included interventions using SMS or MMS as reminders for healthcare appointments. The messaging needed to be between a healthcare provider (either in person or automated) and a patient. The review did not include reminders to people other than those who had an appointment.

We excluded studies in which SMS/MMS was part of a multifaceted intervention, as it would not be possible to separate the effects of messaging alone. SMS messages sent as reminders for routine drug collection for managing long-term conditions were excluded from this review, but discussed in de Jongh 2012 (in press).

We aimed to make comparisons between mobile phone messaging and no intervention, as well as other modes of communication such as face-to-face, postal letters, calls to landline or mobile telephones, email or via electronic health records; and if applicable, automated versus personal text messaging.

#### Types of outcome measures

A number of processes and outcomes may be affected by mobile phone messaging interventions that aim to facilitate the communication between patients and healthcare providers.

##### Primary outcomes

- Rate of attendance at healthcare appointments

##### Secondary outcomes

- Health outcomes as a result of the intervention, including physiological measures, e.g. blood pressure; clinical assessments; biomarker values; self reporting of symptom resolution or quality of life;
- User (patient, carer or healthcare provider) evaluation of the intervention, including satisfaction, readiness to use, timeliness, availability and/or convenience;
- User (patient, carer or healthcare provider) perceptions of safety;
- Costs (direct and indirect) of the intervention;
- Potential harms or adverse effects of the intervention, such as misreading or misinterpretation of data, transmission of inaccurate data, loss of verbal and non-verbal communication

cues, issues of privacy and disclosure, or failure or delay in the message delivery.

## Search methods for identification of studies

We used a common search strategy for all four reviews (this review; de Jongh 2012 (in press); Gurol-Urganci 2012; Vodopivec-Jamsek 2012 (in press)) and allocated relevant studies to their respective reviews before assessing their risk of bias and extracting data. A study may be relevant to, and included in, more than one review. The search strategies for each of the databases are given in Appendix 1 to Appendix 7.

### Electronic searches

We restricted the searches to studies published since 1993 as the first commercial SMS message was sent in December 1992 (Wikipedia 2007). We included LILACS and African Health Anthology because mobile phone messaging applications are increasingly used in low- and middle-income regions. There were no language restrictions.

One review author (IGU) searched the following electronic databases on October 13, 2008 and updated the search on June 22, 2009:

- The Cochrane Central Register of Controlled Trials (CENTRAL, *The Cochrane LIbrary*, issue 2 2009)
- MEDLINE (OvidSP) (1993 to June 22, 2009)
- EMBASE (OvidSP) (1993 to June 22, 2009)
- PsycINFO (OvidSP) (1993 to June 22, 2009)
- CINAHL (EbscoHOST) (1993 to June 22, 2009)
- LILACS (1993 to June 22, 2009)
- African Health Anthology (1993 to June 22, 2009)

### Searching other resources

For grey literature we searched:

- Proceedings from AMIA Congresses;
- WHO Clinical Trial Search Portal (www.who.int/trialsearch);
- Current Controlled Trials (www.controlled-trials.com);
- Dissertation Abstracts International.

We searched the reference lists of included studies to identify additional studies. We contacted study authors for further information on their studies and to enquire whether they were aware of any other published or ongoing studies that would meet our inclusion criteria.

## Data collection and analysis

### Selection of studies

The selection of studies was done by IGU, TdJ and VVJ. IGU and TdJ independently assessed the relevance of all titles and abstracts identified from the electronic searches. We retrieved full text copies of all articles judged to be potentially relevant from the titles and abstracts. TdJ and VVJ independently assessed these articles for inclusion. IGU checked the final list of included and excluded studies, and any disagreements were resolved by discussion with VVJ and JC. We also reviewed the reference lists of key publications. Where the description of the intervention was not sufficiently detailed to allow the review authors to judge whether it met the inclusion criteria, we contacted the study authors for further details.

### Data extraction and management

We extracted the following data from the included studies, using a modified Cochrane Consumers and Communication Review Group's data extraction template:

1. General information: title, authors, source, publication status, date published, language, review author information, date reviewed.
2. Study methods: aims of intervention, aim of study, study design, methods of participant recruitment, inclusion/exclusion criteria, informed consent and ethical approval, funding.
3. Risk of bias: data to be extracted depends on the study design (see 'Assessment of risk of bias in included studies').
4. Participants: description, geographic location, setting, number, age, gender, ethnicity, socioeconomic status distribution. If relevant: principal health problem or diagnosis, stage of illness, treatment received.
5. Providers: description, geographic location, setting, age, gender.
6. Interventions: description including technical specifications on SMS and handset provider, duration of intervention, purpose of intervention, initiator of intervention, message content, details of control/usual or routine care, co-interventions.
7. Outcomes: primary and secondary outcomes as specified above, methods of assessing outcomes, follow up for non-respondents, timing of outcome assessment, adverse events.
8. Results: all reported measurements for the primary and secondary outcomes, including multiple timings for measurements, subgroup analyses or results in different measurement scales if applicable.

TdJ and VVJ independently extracted the above data onto a standard form. The forms were then assessed by one review author (IGU) who checked these descriptive data. Any discrepancies between the two data extraction sheets were discussed by two review authors (TdJ and VVJ), and resolved jointly with the two other review authors (IGU and JC). For missing data, we contacted the study authors to obtain the missing information.

### Assessment of risk of bias in included studies

We assessed the risk of bias of included studies in accordance with the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011) which recommends the explicit reporting of sequence generation, allocation concealment, blinding of participants, providers and outcome assessors, incomplete outcome data, selective outcome reporting and other sources of bias for RCTs.
Had studies using other study designs been identified for inclusion in the review, we would have assessed these using a variation of the above tool.
Two review authors (TdJ and VVJ) independently assessed the risk of bias in the included studies, with any disagreements resolved by discussion and consensus of the team. We used a template to guide the assessment of risk of bias, and judged each domain as 'yes' (indicating a low risk of bias), 'no' (indicating a high risk of bias) or 'unclear' (indicating an uncertain risk of bias).
We have presented the results of the risk of bias assessment in tables, and provided a narrative discussion of risk of bias in individual domains.

### Measures of treatment effect

We used risk ratios (RR) as effect measures for dichotomous outcomes and standardised mean differences (SMD) for continuous outcomes. RR and SMDs have been derived from Manzel-Haenszel and inverse variance methods respectively. We used a random-effects model, where possible, to pool the results and reported confidence intervals with all measures of effect.

### Unit of analysis issues

We noted the method of randomisation in each included trial, and considered additional issues regarding the assessment of risk of bias of cluster randomised trials as discussed in Chapter 16 of the Cochrane Handbook (Higgins 2011). In the case of repeated measurements, we defined several outcomes based on different periods of follow-up and performed separate analyses for each outcome. In studies with more than two treatment groups, we made multiple pair-wise comparisons between all possible pairs of intervention groups.

### Dealing with missing data

We contacted the original investigators to request missing data. With incomplete outcome data (such as drop-outs, loss to follow-up and withdrawn study participants), we assessed and reported the risk of bias as high/unclear/low risk as guided by the Cochrane Handbook (Higgins 2011) and identified the numbers as well as the reasons for incomplete data. As the numbers and reasons for incomplete outcome data in included studies suggested that data were missing at random, we used only available data in the review and did not use imputation methods.

### Assessment of reporting biases

We assessed reporting bias using funnel plots. The funnel plots, however, were not very informative due to the small number of studies included. Selective outcome reporting was assessed using the Cochrane Risk of Bias assessment tool.

### Data synthesis

We conducted a meta-analysis using Cochrane Review Manager (RevMan) software to calculate an overall effect size, comparing text message reminders with alternative modes of communicating reminders. We used the $Chi^2$ test to test for heterogeneity in outcomes. We used a random-effects model in the meta-analysis of the calculated measures of effect as described in Measures of treatment effect.

### Subgroup analysis and investigation of heterogeneity

We were unable to conduct subgroup analyses by participant age (0 to 18, 18 to 55, over 55), as planned, due to absence of data for subgroups.

### Sensitivity analysis

We did not conduct the planned sensitivity analyses due to the small number of studies included. We had aimed to explore the influence of the following factors on effect size:

- excluding unpublished studies;
- taking account of risk of bias of included studies, as specified above;
- excluding any large studies to establish how they impact on the results;
- excluding studies using the following filters: language of publication, source of funding (industry versus other), country;
- the length of the interval between delivery of the intervention and measurement of the effect.

#### Consumer participation

The draft review was circulated for peer review by consumers in The Cochrane Collaboration. The review received comments from two consumers through the Cochrane Consumers and Communication Review Group'sstandard editorial process. We also examined whether consumers were involved in the design and implementation of each included study.

## RESULTS

### Description of studies

See: Characteristics of included studies; Characteristics of excluded studies.

## Results of the search

Our search (across all four reviews) identified 3937 citations. We excluded 3750 citations that, based on the abstract alone, showed insufficient relevance to the suite of reviews or did not meet the stated study design criteria. After review of the full text of the remaining 187 citations, a further 175 were subsequently rejected from this review for failing to meet the inclusion criteria. In the final selection stage, out of the remaining 12 citations, we excluded 7 studies, cited in 8 papers, from this review because the studies did not meet the specified study design criteria.

## Included studies

We included four studies in this review (Chen 2008; Fairhurst 2008; Koury 2005; Leong 2006;). We present key characteristics of the included studies below and in the Characteristics of included studies table.

### Methods

All included studies were RCTs. In three studies the unit of randomisation was the individual participant (Chen 2008; Koury 2005; Leong 2006). In one study the unit of randomisation was the healthcare appointment (Fairhurst 2008). Studies were conducted over 2 months (Chen 2008), 3 months (Leong 2006), 7 months (Fairhurst 2008), and 9 months (Koury 2005) respectively.

All studies compared the effects of the text messaging intervention to usual practice. In three studies usual practice was no reminders. In Koury 2005, the usual practice was to send postal reminders two weeks before appointments. Chen 2008 and Leong 2006 had a second intervention arm of phone call reminders and compared the effects of the text messaging intervention to call reminders. The sample sizes for the included studies ranged from 291 (Koury 2005) to 1848 participants (Chen 2008).

### Participants

The studies were set in China (Chen 2008), Scotland (Fairhurst 2008), England (Koury 2005) and Malaysia (Leong 2006). The settings were one hospital health promotion centre, one inner-city general practice, six ENT clinics (in one hospital), and seven primary care clinics, respectively.

The target group for the intervention varied. In three of the studies, all patients that required an appointment in the clinic or practice were eligible for the study. Chen 2008 notes that the health promotion centre in China mainly attracted middle and high income employees or owners of local companies. In Fairhurst 2008, the participants included only those with a history of two or more failed appointments within one year.

The participants' mean age was 33 years in Fairhurst 2008, 38 years in Leong 2006 and 57 years in Chen 2008. All studies included both men and women, the proportion of males ranged from 35% to 58%. Koury 2005 did not provide any information on the age and gender distribution of the participants.

### Interventions

#### Purpose

The purpose of all interventions in the four studies was to remind the participant of their upcoming healthcare appointment.

#### Specifications

The text messaging interventions were delivered using different platforms. In Fairhurst 2008 and Koury 2005, texts were sent using a web-based provider, and in Chen 2008 texts were sent automatically via a Global System for Mobile (GSM) modem linked to an electronic health records system. No information on the text messaging specifications was provided in Leong 2006. The delivery of the messages was verified by 'message sent' prompts in all studies. Chen 2008 notes, however, that as mobile phone numbers are changed frequently in China, the authors could not verify whether the message was delivered to the correct recipient.

#### Message content

Chen 2008 and Leong 2006 state that the text message reminders included the participant's name and appointment details, but neither study provides any further details. The reminder in Fairhurst 2008 was "You have an appointment at (name of practice) (today/tomorrow) at (time). Please call (number) if you can't make it." Koury 2005 provided no information on message content.

#### Timing of the reminder

The text reminder was sent 24 hours before the appointment in Koury 2005, 24 to 48 hours before the appointment in Leong 2006 and 72 hours before the appointment in Chen 2008. In Fairhurst 2008, reminders were sent between 08:00 and 09:00 on the morning preceding afternoon appointments, and between 16:00 and 17:00 on the afternoon preceding morning appointments. Reminders for Monday morning appointments were sent on the previous Friday afternoon.

### Outcomes

All studies reported attendance rates at healthcare appointments. Two studies (Chen 2008; Leong 2006) reported cost of the intervention. Koury 2005 also reported the proportion of participants contacted who had a mobile phone and who were willing to be contacted by SMS. While these latter measures are not outcomes

of the intervention, we include them as measures of user evaluation of the intervention (readiness to use, availability or convenience).

### Risk of bias in included studies

We summarise the risk of bias in included studies in Figure 1 and Figure 2.

**Figure 1. Risk of bias summary: review authors' judgements about each risk of bias item for each included study.**

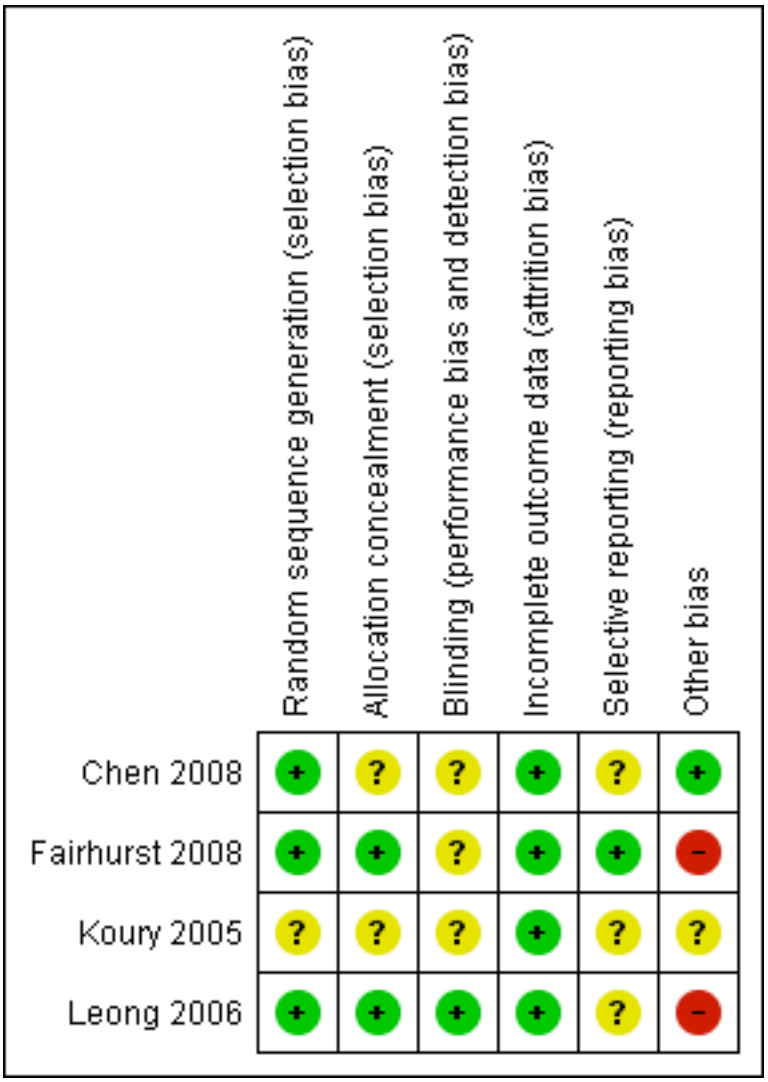
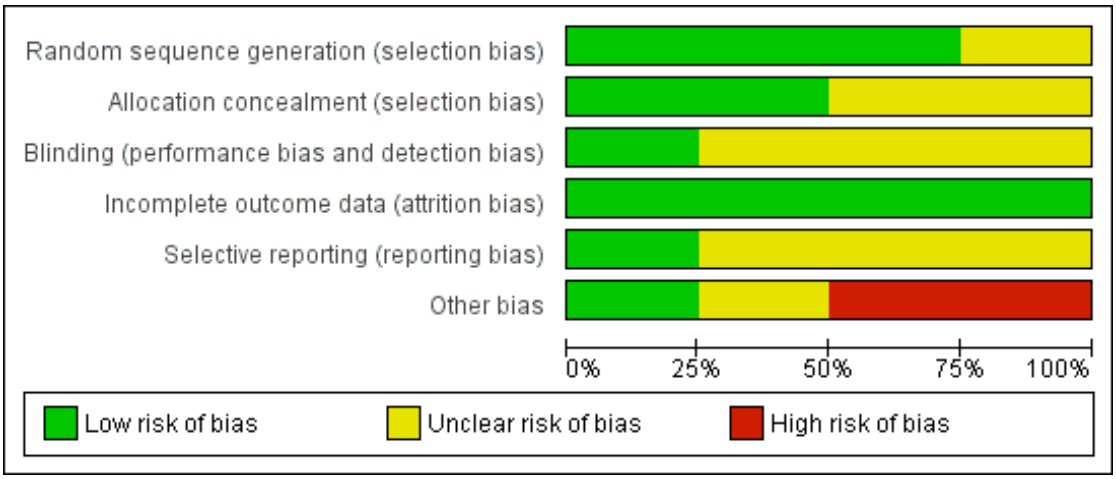


**Figure 2. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.**




Three studies reported the use of adequate sequence generation methods (computer generated random allocation sequences or random number tables); one study did not specify the method of randomisation (Koury 2005).

Though not stated in any of the studies, we assumed there was no blinding of participants, healthcare providers or outcome assessors in any of the studies. In Leong 2006, the person who conducted the randomisation was not involved in participant recruitment and intervention delivery. No mention is made in other studies of blinding of outcome assessors/researchers and this could have potentially introduced a source of bias.

Because we were not able to review the original study protocols, we cannot draw fully informed inferences on potential selective reporting. In addition, only one included study reported adverse effects as an outcome (Fairhurst 2008). Intervention and control groups were sufficiently comparable in all studies.

In all studies it was reported that the intervention and control groups were comparable at baseline; however, no further information is provided in Koury 2005.

Although the time lapse between the reminder and the appointment could have had an effect on the outcome, none of the studies assessed this variable. In Fairhurst 2008, as the unit of analysis is the appointment rather than individual patient who may have more than one appointment in the study period, there is clustering of data. In Leong 2006, the effect size is likely to be underestimated as the definition of 'attendance' is restricted to attendance at the clinics on scheduled days. The participants in the study were accustomed to walk-in visits rather than scheduled visits and 48 % of the participants actually attended the clinic, but on days other than the appointment dates.

## Effects of interventions

See: **Summary of findings for the main comparison** Mobile phone text message reminders compared to no reminders for patients with healthcare appointments; **Summary of findings 2** Mobile phone message text reminders plus postal reminders compared to postal reminders alone for patients with scheduled healthcare appointments; **Summary of findings 3** Mobile phone message reminders compared to phone call reminders for patients with healthcare appointments

### Attendance at healthcare appointments

Text message reminders improved the rate of attendance at healthcare appointments compared with no reminders (risk ratio (RR) 1.10; 95% confidence interval (CI) 1.03 to 1.17) (Summary of findings for the main comparison; Figure 3) and postal reminders (RR 1.10, 95% CI 1.02 to 1.19) (Summary of findings 2; Figure 4). However, text messages and phone reminders had similar effects on attendance (RR 0.99, 95% CI 0.95 to 1.03) (Summary of findings 3; Figure 5).

**Figure 3. Forest plot of comparison: 1 Mobile phone text message reminders vs no reminders, outcome: 1.1 Attendance rate at healthcare appointments.**

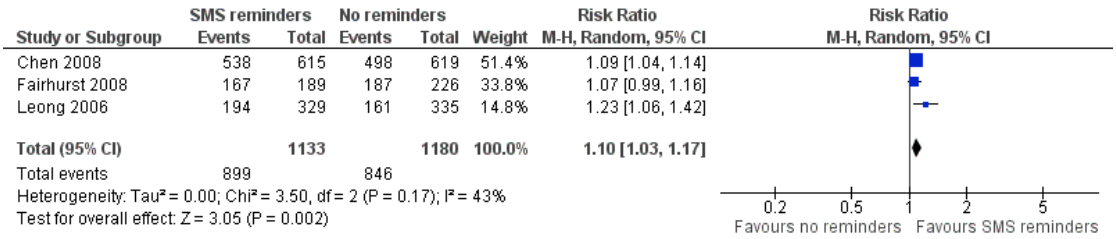



**Figure 4. Forest plot of comparison: 2 Mobile phone message text reminders plus postal reminders vs postal reminders, outcome: 2.1 attendance rate of scheduled healthcare appointments.**

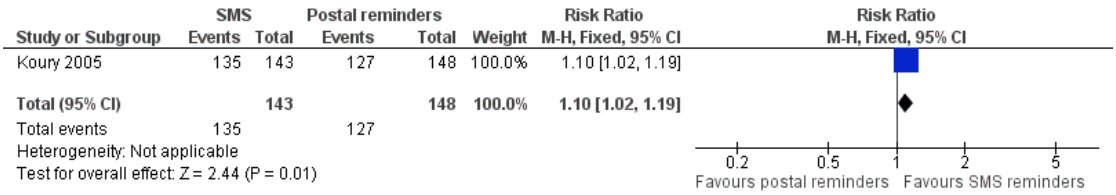
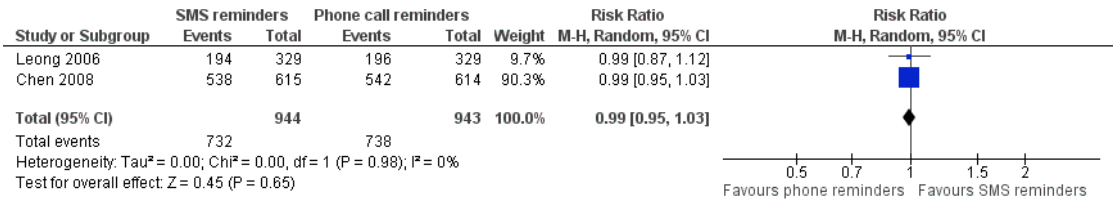



**Figure 5. Forest plot of comparison: 3 Mobile phone message reminders vs phone call reminders, outcome: 3.1 Attendance rate at healthcare appointments.**




### Costs and cost-effectiveness

Two studies measured the cost per unit of effective intervention of text message versus telephone reminder (Chen 2008; Leong 2006). While the attendance rates after text messages versus phone reminders were similar, the costs per text message were lower than costs per phone call reminder in both studies. The relative cost of the text message reminders per attendance was 55% and 65% of the cost of phone call reminders in Leong 2006 and Chen 2008, respectively (Table 2).

### User evaluation of the intervention

One study reported the pre-intervention acceptability of the intervention and found that 98% of patients were willing to receive routine mobile phone text message reminders of their outpatient appointments (Koury 2005; Table 2).

### Potential harms or adverse effects of the intervention

One study comparing the effects of mobile phone text message reminders to phone call reminders reported that there were no

adverse effects during the study period (Fairhurst 2008), although there was no indication of what adverse events were considered in this study. None of the studies specifically reported events such as misreading or misinterpretation of data, transmission of inaccurate data, loss of verbal and non-verbal communication cues, issues of privacy and disclosure, or failure or delay in the message delivery.

### Other outcomes

None of the included studies reported on health outcomes or user perception of safety related to the intervention.

## ADDITIONAL SUMMARY OF FINDINGS *[Explanation]*

**Patient or population:** Patients with healthcare appointments
**Settings:** all settings (primary, hospital, community, outpatient)
**Intervention:** Mobile phone message text plus postal reminders
**Comparison:** Postal reminders

| Outcomes | Illustrative comparative risks* (95% CI) | | Relative effect (95% CI) | No of Participants (studies) | Quality of the evidence (GRADE) |
|---|---|---|---|---|---|
| | Assumed risk | Corresponding risk | | | |
| | Postal reminders | Mobile phone message text plus postal reminders | | | |
| Attendance rate at healthcare appointments | 858 per 1000 | 944 per 1000 (875 to 1000) | RR 1.1 (1.02 to 1.19) | 291 (1 study) | ⊕⊕◯◯ low[1] |
| Other outcomes | The included study did not report on health outcomes, user evaluation of the intervention, user perception of safety, costs, potential harms or adverse events of the intervention | | | | |

*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; **RR:** Risk 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] No information provided about the method of randomisation, allocation concealment, blinding and selective outcome reporting (unclear risk of bias). Low risk only for attrition bias.

**Mobile phone message reminders compared to phone call reminders for patients with healthcare appointments**

**Patient or population:** patients with healthcare appointments
**Settings:** all settings (primary, hospital, community, outpatient)
**Intervention:** Mobile phone message reminders
**Comparison:** phone call reminders

| Outcomes | Illustrative comparative risks* (95% CI) | | Relative effect (95% CI) | No of Participants (studies) | Quality of the evidence (GRADE) |
|---|---|---|---|---|---|
| | Assumed risk | Corresponding risk | | | |
| | Phone call reminders | Mobile phone message reminders | | | |
| Attendance rate at healthcare appointments | 783 per 1000 | 775 per 1000 (743 to 814) | RR 0.99 (0.95 to 1.03) | 1887 (2 studies) | ⊕⊕⊕◯ moderate[1,2] |
| Costs | While the attendance rates after text messages versus phone reminders were similar, the costs per text message per attendance were 55% and 65% lower that costs per phone call reminder in included studies | | | | |
| Other outcomes | None of the included studies reported on health outcomes, user evaluation of the intervention, user perception of safety, potential harms or adverse events of the intervention | | | | |

*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; **RR:** Risk 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] Unclear risk of bias for several categories in the included studies.
[2] In one study the unit of analysis was appointment rather than individual participant which may have resulted in clustering of data.

# DISCUSSION

## Summary of main results

Low and moderate quality evidence shows that mobile phone text message reminders increase healthcare appointment attendance rates when compared to no reminders and postal reminders, respectively. Further, we found moderate quality evidence that mobile phone text message reminders are as effective as phone call reminders. Two studies reported that mobile phone text message reminders are more cost-effective than phone call reminders. However, we found very limited evidence about the potential adverse effects, or user satisfaction. Overall, there is a need for more high-quality research about the effects of mobile phone message reminders.

## Overall completeness and applicability of evidence

We identified two studies from Asia and two from the UK, covering lower-middle income (China) to high income countries (England, Scotland). We found limited evidence in favour of text messaging for reminders for healthcare appointments. However, as our review contains a relatively small number studies, it is difficult to assess to what extent our findings have more general relevance.

None of the studies included in this review evaluated potential complications from text messaging such as loss or misinterpretation of data. No consideration was given to issues of security and confidentiality. Particularly in low-income countries where mobile phones are frequently shared between family members, these are important confidentiality issues that need to be taken into account when designing interventions using SMS.

## Quality of the evidence

The included studies were of varying methodological quality; most of them provided insufficient information to accurately assess the risk of bias. On the whole, sequence generation for randomisation was considered adequate (although randomisation method was unclear in one study) but in two studies it was not clear whether, and how, the allocation was concealed. The lack of blinding in all studies can be partly explained by the interactive nature of the text message interventions, which does not permit the blinding of participants or their healthcare providers. There is, however, a potential for bias from the apparent lack of blinding of outcome assessors. Our review has exposed important gaps in the current knowledge in this area which merit further research.

## Potential biases in the review process

We believe that we have identified all the studies concerning the use of mobile phone messaging reminders for attendance at healthcare appointments that met our study design criteria (RCT, CBA, ITT) up to June 2009, as we had a comprehensive search strategy and independent assessment for inclusion eligibility, risk of bias and data extraction. However, by excluding studies with possible confounding from other communication and/or data transmission methods, we may have introduced selection bias towards less successful interventions, as more complex interventions may be more effective at improving attendance rates.

## Agreements and disagreements with other studies or reviews

This review comes in the wake of two other recent reviews that analyse text messaging interventions. Fjeldsoe 2009 reviewed the evidence for behaviour change interventions delivered by SMS, whereas Krishna 2009 more broadly looked at healthcare delivery via mobile phones in the management and prevention of disease. Neither of the studies commented on reminders for attendance at healthcare appointments. The review complements Jacobson Vann 2005 which assesses the effects of various reminder interventions for improving vaccination rates, although we note that that review does not include any studies of mobile phone text messaging.

# AUTHORS' CONCLUSIONS

## Implications for practice

The studies included in this review comprise four randomised controlled trials. The studies used attendance rates (or non-attendance in one case) and in two studies cost as the end point measures. Health effects of the intervention were not measured.

This review shows that mobile phone messaging reminders increase attendance at healthcare appointments when compared to no reminders or postal reminders. Text messaging reminders were similar to telephone reminders in terms of their effect on attendance rates, and were more cost-effective than telephone reminders. However, the included studies were heterogeneous and the quality of the evidence therein is low to moderate, which makes the findings difficult to generalise. Further, there is a lack of information about adverse effects and consumer satisfaction with the intervention.

## Implications for research

There is a need for more high-quality randomised trials that measure not only patients' attendance rates but also costs, cost-effectiveness, patients' and healthcare providers' evaluation of the interventions, potential harms, and adverse effects. Studies should

report message content and timing in relation to the appointment. Further research should particularly focus on older patients, given that this population has, on average, more healthcare appointments and uses mobile phones less frequently than the younger population.

## ACKNOWLEDGEMENTS

We acknowledge the very helpful support of the Cochrane Consumers and Communication Review Group editorial base in different stages of this review.

## REFERENCES

### References to studies included in this review

**Chen 2008** *{published data only}*
Chen ZW, Fang LZ, Chen LY, Dai HL. Comparison of an SMS text messaging and phone reminder to improve attendance at a health promotion center: A randomized controlled trial. *Journal of Zhejiang University: Science B* 2008;**9**(1):34–8.

**Fairhurst 2008** *{published data only}*
Fairhurst K, Sheikh A. Texting appointment reminders to repeated non-attenders in primary care: randomised controlled study. *Quality and Safety in Health Care* 2008;**17**(5):373–6.

**Koury 2005** *{published data only}*
Koury E, Faris C. Mobile phones and clinic appointments: the start of a beautiful new friendship?. *British Journal of Healthcare Computing & Information Management* 2005;**22**(8):18–20.

**Leong 2006** *{published data only}*
Leong KC, Chen WS, Leong KW, Mastura I, Mimi O, Sheikh MA, et al.The use of text messaging to improve attendance in primary care: a randomized controlled trial. *Family Practice* 2006;**23**(6):699–705.

### References to studies excluded from this review

**Bos 2005** *{published data only}*
Bos A, Hoogstraten J, Prahl-Andersen B. Failed appointments in an orthodontic clinic. *American Journal of Orthodontics and Dentofacial Orthopedics* 2005;**127**(3):355–7.

**Car 2008** *{published data only}*
Car J, Ng C, Atun R, Card A. SMS text message healthcare appointment reminders in England. *Journal of Ambulatory Care Management* 2008;**31**(3):216–9.

**Downer 2005** *{published data only}*
Downer SR, Meara JG, Da Costa AC. Use of SMS text messaging to improve outpatient attendance. *Medical Journal of Australia* 2005;**183**(7):366–8.
Downer SR, Meara JG, Da Costa AC, Sethuraman K. SMS text messaging improves outpatient attendance. *Australian Health Review* 2006;**30**(3):389–96.

**Geraghty 2008** *{published data only}*
Geraghty M, Glynn F, Amin M, Kinsella J. Patient mobile telephone 'text' reminder: A novel way to reduce non-attendance at the ENT out-patient clinic. *Journal of Laryngology and Otology* 2008;**122**(3):296–8.

**Koshy 2008** *{published data only}*
Koshy E, Car J, Majeed A. Effectiveness of mobile-phone short message service (SMS) reminders for ophthalmology outpatient appointments: Observational study. *BMC Ophthalmology* 2008;**8**(9).

**Kruse 2009** *{published data only}*
Kruse LV, Hansen LG, Olesen C. [Non-attendance at a pediatric outpatient clinic. SMS text messaging improves attendance]. *Ugeskr Laeger* 2009;**171**(17):1372–5.

**Milne 2006** *{published data only}*
Milne RG, Horne M, Torsney B. SMS reminders in the UK National Health Service: An evaluation of its impact on "no-shows" at Hospital Out-Patient Clinics. *Health Care Management Review* 2006;**31**(2):130–6.

### Additional references

**Adler 2007**
Adler R. *Health care unplugged: the evolving role of wireless technology*. Chronic Health Care Foundation, 2007.

**Al Faris 2002**
Al Faris EA, Abdulghani HM, Mahdi AH, Salih MA, Al Kordi AG. Compliance with appointments and medications in a pediatric neurology clinic at a University Hospital in Riyadh, Saudi Arabia. *Saudi Medical Journal* 2002;**23**(8):969–74.

**Atun 2006**
Atun RA, Sittampalam S. A review of the characteristics and benefits of SMS in delivering healthcare. In: Atun RA editor(s). *The role of mobile phones in increasing accessibility and efficiency in healthcare*. Vodafone Group Plc., 2006.

**Atun 2006b**
Atun RA, Gurol-Urganci I. Analysis of calls to NHS Direct. In: Atun RA editor(s). *The role of mobile phones in increasing accessibility and efficiency in healthcare*. Vodafone Group Plc., 2006.

**Bauer 2003**
Bauer S, Percevic R, Okon E, Meermann R, Kordy H. Use of text messaging in the aftercare of patients with bulimia nervosa. *European Eating Disorders Review* 2003;**11**(3): 279–90.

**Baumgart 2005**
Baumgart DC. Personal digital assistants in health care: experienced clinicians in the palm of your hand?. *Lancet* 2005;**366**(9492):1210–22.

**Bech 2005**
Bech M. The economics of non-attendance and the expected effect of charging a fine on non-attendees. *Health Policy* 2005;**74**(2):181–91.

**Bottomley 1994**
Bottomley WW, Cotterill JA. An audit of the factors involved in new patient non-attendance in a dermatology out-patient department. *Clinical and Experimental Dermatology* 1994;**19**(5):399–400.

**Brown 1999**
Brown KA, Shetty V, Delrahim S, Belin T, Leathers R. Correlates of missed appointments in orofacial injury patients. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics* 1999;**87**(4):405–10.

**Campbell 2000**
Campbell JD, Chez RA, Queen T, Barcelo A, Patron E. The no-show rate in a high-risk obstetric clinic. *Journal of Women's Health & Gender-Based Medicine* 2000;**9**(8):891–5.

**Can 2003**
Can S, Macfarlane T, O'Brien KD. The use of postal reminders to reduce non-attendance at an orthodontic clinic: A randomised controlled trial. *British Dental Journal* 2003;**195**(4):199–201.

**Canizares 2002**
Canizares MJ, Penneys NS. The incidence of nonattendance at an urgent care dermatology clinic. *Journal of the American Academy of Dermatology* 2002;**46**(3):457–9.

**Car 2003**
Car J, Sheikh A. Telephone consultations. *BMJ* 2003;**326** (7396):966–9.

**Car 2004**
Car J, Sheikh A. Email consultations in health care: 1-scope and effectiveness. *BMJ* 2004;**329**(7463):435–8.

**Car 2004b**
Car J, Sheikh A. Email consultations in health care: 2-acceptability and safe application. *BMJ* 2004;**329**(7463): 439–42.

**Carrion 1993**
Carrion PG, Swann A, Kellert-Cecil H, Barber M. Compliance with clinic attendance by outpatients with schizophrenia. *Hospital and Community Psychiatry* 1993;**44** (8):764–7.

**Cashman 2004**
Cashman SB, Savageau JA, Lemay CA, Ferguson W. Patient health status and appointment keeping in an urban community health center. *Journal of Healthcare for the Poor and Underserved* 2004;**15**(3):474–88.

**Catz 1999**
Catz SL, McClure JB, Jones GN, Brantley PJ. Predictors of outpatient medical appointment attendance among persons with HIV. *AIDS Care* 1999;**11**(3):361–73. [MEDLINE: 159]

**Chung 2004**
Chung JW, Wong TK, Yeung AC. Non-attendance at an orthopaedic and trauma specialist outpatient department of a regional hospital. *Journal of Nursing Management* 2004;**12** (5):362–7.

**Clarke 1998**
Clarke EA, Notghi A, Harding LK. Counting the cost of patients who do not attend nuclear medicine departments. *Nuclear Medicine Communications* 1998;**19**(3):193–7.

**Collins 2003**
Collins J, Santamaria N, Clayton L. Why outpatients fail to attend their scheduled appointments: a prospective comparison of differences between attenders and non-attenders. *Australian Health Review* 2003;**26**(1):52–63.

**Coodin 2004**
Coodin S, Staley D, Cortens B, Desrochers R, McLandress S. Patient factors associated with missed appointments in persons with schizophrenia. *Canadian Journal of Psychiatry* 2004;**49**(2):145–8.

**de Jongh 2012 (in press)**
de Jongh T, Gurol-Urganci I, Vodopivec-Jamsek V, Car J, Atun R. Mobile phone messaging telemedicine for facilitating self management of long-term illnesses (in press). *Cochrane Database of Systematic Reviews* 2012. [DOI: 10.1002/14651858.CD007459]

**Deyo 1980**
Deyo RA, Inui TS. Dropouts and broken appointments. A literature review and agenda for future research. *Medical Care* 1980;**18**(11):1146–57.

**Dini 1995**
Dini EF, Linkins RW, Chaney M. Effectiveness of computer-generated telephone messages in increasing clinic visits. *Archives of Pediatrics and Adolescent Medicine* 1995;**149**(8): 902–5.

**DoH 2004**
Department of Health. Missed appointments guidance. GP Bulletin 2004, issue 33.

**DPP 2003**
DPP. DPP: Developing Patient Partnerships. www.dpp.org.uk 2003.

**Dyer 2003**
Dyer O. Patients will be reminded of appointments by text messages. *BMJ* 2003;**326**(7402):1281. [MEDLINE: 4001]

**Ellenbogen 2003**
Ellenbogen J. Preference for text message reminders may be greatest in lower socio-economic groups. *BMJ* 2003;**327**: 564–e.

**Fahey 2003**
Fahey D. Reminding patients by text message: text reminders could lead to increased health inequalities. *BMJ* 2003;**327**(7414):564.

**Fairley 2003**
Fairley CK, Levy R, Rayner CR, Allardice K, Costello K, Thomas C. Randomized trial of an adherence programme for clients with HIV. *International Journal of STD & AIDS* 2003;**14**(12):805–9.

**Ferrer-Roca 2004**
Ferrer-Roca O, Cardenas A, Diaz-Cardama A, Pulido P. Mobile phone text messaging in the management of diabetes. *Journal of Telemedicine and Telecare* 2004;**10**(5): 282–5.

**Fjeldsoe 2009**
Fjeldsoe BS, Marshall AL, Miller YD. Behavior change interventions delivered by mobile telephone short-message service. *American Journal of Preventive Medicine* 2009;**36** (2):165–73.

**Franklin 2003**
Franklin V, Waller A, Pagliari C, Greene S. "Sweet Talk": text messaging support for intensive insulin therapy for young people with diabetes. *Diabetes Technology & Therapeutics* 2003;**5**(6):991–6.

**Gatrad 1997**
Gatrad AR. Comparison of Asian and English non-attenders at a hospital outpatient department. *Archives of Disease in Childhood* 1997;**77**(5):423–6.

**Gatrad 2000**
Gatrad AR. A completed audit to reduce hospital outpatients non-attendance rates. *Archives of Disease in Childhood* 2000; **82**(1):59–61.

**George 2003**
George A, Rubin G. Non-attendance in general practice: a systematic review and its implications for access to primary health care. *Family Practice* 2003;**20**(2):178–84.

**Grunebaum 1996**
Grunebaum M, Luber P, Callahan M, Leon AC, Olfson M, Portera L. Predictors of missed appointments for psychiatric consultations in a primary care clinic. *Psychiatric Services* 1996;**47**(8):848–52.

**Gurol-Urganci 2012**
Gurol-Urganci I, de Jongh T, Vodopivec-Jamsek V, Car J, Atun R. Mobile phone messaging for communicating results of medical investigations. *Cochrane Database of Systematic Reviews* 2012, Issue 6. [DOI: 10.1002/14651858.CD007456.pub2]

**Hamilton 2002**
Hamilton W, Round A, Sharp D. Patient, hospital, and general practitioner characteristics associated with non-attendance: a cohort study. *British Journal of General Practice* 2002;**52**(477):317–9.

**Hashim 2001**
Hashim MJ, Franks P, Fiscella K. Effectiveness of telephone reminders in improving rate of appointments kept at an outpatient clinic: a randomized controlled trial. *Journal of the American Board of Family Medicine* 2001;**14**(3):193–6.

**Herrick 1994**
Herrick J, Gilhooly ML, Geddes DA. Non-attendance at periodontal clinics: forgetting and administrative failure. *Journal of Dentistry* 1994;**22**(5):307–9.

**Higgins 2011**
Higgins JPT, Green S (editors). *Cochrane Handbook for Systematic Reviews of Interventions Version 5.1 [updated March 2011].* The Cochrane Collaboration. Available from www.cochrane-handbook.org, 2011.

**Hon 2002**
Hon KL, Leung TF, Ma KC. Issues regarding nonattendance at a paediatric dermatology centre. *Clinical and Experimental Dermatology* 2002;**27**(8):711–3.

**Hon 2005**
Hon KL, Leung TF, Wong Y, Ma KC, Fok TF. Reasons for new referral non-attendance at a pediatric dermatology center: a telephone survey. *Journal of Dermatological Treatment* 2005;**16**(2):113–6.

**Hull 2002**
Hull AM, Alexander DA, Morrison F, McKinnon JS. A waste of time: non-attendance at out-patient clinics in a Scottish NHS Trust. *Health Bulletin (Edinborough)* 2002; **60**(1):62–9.

**Husain-Gambles 2004**
Husain-Gambles M, Neal RD, Dempsey O, Lawlor DA, Hodgson J. Missed appointments in primary care: questionnaire and focus group study of health professionals. *British Journal of General Practice* 2004;**54**(499):108–13.

**Iben 2000**
Iben P, Kanellis MJ, Warren J. Appointment-keeping behavior of Medicaid-enrolled pediatric dental patients in eastern Iowa. *Pediatric Dentistry* 2000;**22**(4):325–9.

**ITU 2010**
International Telecommunications Union. The World in 2010: ICT Facts and Figures. http://www.itu.int/ITU-D/ict/material/FactsFigures2010.pdf 2010.

**Jacobson Vann 2005**
Jacobson Vann JC, Szilagyi P. Patient reminder and recall systems to improve immunization rates. *Cochrane Database of Systematic Reviews* 2005, Issue 3. [DOI: 10.1002/14651858.CD003941.pub2]

**Kane 1991**
Kane K. Non-attendance for appointments in an out-patients' x-ray department. *Radiography Today* 1991;**57** (653):15–9. [MEDLINE: 1]

**Kaplan 2006**
Kaplan WA. Can the ubiquitous power of mobile phones be used to improve health outcomes in developing countries?. *Global Health* 2006 May 23;**2**:9. [PUBMED: 16719925]

**Killaspy 2000**
Killaspy H, Banerjee S, King M, Lloyd M. Prospective controlled study of psychiatric out-patient non-attendance. Characteristics and outcome. *British Journal of Psychiatry* 2000;**176**:160–5.

**King 1995**
King A, David D, Jones HS, O'Brien C. Factors affecting non-attendance in an ophthalmic outpatient department. *Journal of the Royal Society of Medicine* 1995;**88**(2):88–90.

**Krishna 2009**
Krishna S, Boren S A, Balas E A. Healthcare via cell phones: A systematic review. *Telemedicine and e-Health* 2009;**15**(3): 231–40. [PUBMED: 19382860]

**Kwon 2004**
Kwon HS, Cho JH, Kim HS, Lee JH, Song BR, Oh JA, et al.Development of web-based diabetic patient management system using short message service (SMS). *Diabetes Research and Clinical Practice* 2004;**66 Suppl 1**:S133–7.

**Lasser 2005**
Lasser KE, Mintzer IL, Lambert A, Cabral H, Bor DH. Missed appointment rates in primary care: the importance of site of care. *Journal of Health Care for the Poor and Underserved* 2005;**16**(3):475–86.

**Livianos-Aldana 1999**
Livianos-Aldana L, Vila-Gomez M, Rojo-Moreno L, Luengo-Lopez MA. Patients who miss initial appointments in community psychiatry? A Spanish community analysis. *International Journal of Social Psychiatry* 1999;**45**(3): 198–206.

**Lloyd 1993**
Lloyd M, Bradford C, Webb S. Non-attendance at outpatient clinics: is it related to the referral process?. *Family Practice* 1993;**10**(2):111–7.

**Majeroni 1996**
Majeroni BA, Cowan T, Osborne J, Graham RP. Missed appointments and Medicaid managed care. *Archives of Family Medicine* 1996;**5**(9):507–11.

**Mantyjarvi 1994**
Mantyjarvi M. No-show patients in an ophthalmological out-patient department. *Acta Ophthalmologica Scandinavica* 1994;**72**(3):284–9.

**Marquez Contreras 2004**
Marquez Contreras E, de la Figuera von Wichmann M, Gil-Guillen V, Ylla-Catala A, Figueras M, Balana M, et al.[Effectiveness of an intervention to provide information to patients with hypertension as short text messages and reminders sent to their mobile phone (HTA-Alert)]. *Atencion Primaria* 2004;**34**(8):399–405.

**Martin 2005**
Martin C, Perfect T, Mantle G. Non-attendance in primary care: the views of patients and practices on its causes, impact and solutions. *Family Practice* 2005;**22**(6):638–43.

**Mirotznik 1998**
Mirotznik J, Ginzler E, Zagon G, Baptiste A. Using the health belief model to explain clinic appointment-keeping for the management of a chronic disease condition. *Journal of Community Health* 1998;**23**(3):195–210.

**Mohamed 2002**
Mohamed BA, Al Doghaither AH. Missed appointments at public hospitals in Riyadh, Saudi Arabia. *Saudi Medical Journal* 2002;**23**(4):388–92.

**Moore 2001**
Moore CG, Wilson-Witherspoon P, Probst JC. Time and money: effects of no-shows at a family practice residency clinic. *Family Medicine* 2001;**33**(7):522–7.

**Murdock 2002**
Murdock A, Rodgers C, Lindsay H, Tham TC. Why do patients not keep their appointments? Prospective study in a gastroenterology outpatient clinic. *Journal of the Royal Society of Medicine* 2002;**95**(6):284–6.

**Neal 2001**
Neal RD, Lawlor DA, Allgar V, Colledge M, Ali S, Hassey A, et al.Missed appointments in general practice: retrospective data analysis from four practices. *British Journal of General Practice* 2001;**51**(471):830–2.

**Neal 2005**
Neal RD, Hussain-Gambles M, Allgar VL, Lawlor DA, Dempsey O. Reasons for and consequences of missed appointments in general practice in the UK: questionnaire survey and prospective review of medical records. *BMC Family Practice* 2005;**6**:47.

**Newell 2001**
Newell A. A mobile phone text message and Trichomonas vaginalis. *Sexually Transmitted Infections* 2001;**77**(3):225.

**Norwell 2003**
Norwell N. Text messaging raises medicolegal issues. *BMJ* 2003;**326**(7399):1148.

**Obermayer 2004**
Obermayer JL, Riley WT, Jean-Mary J. College smoking-cessation using cell phone text messaging. *Journal of American College Health* 2004;**53**(2):71–8. [MEDLINE: 4688]

**Ostojic 2005**
Ostojic V, Cvoriscec B, Ostojic SB, Reznikoff D, Stipic-Markovic A, Tudjman Z. Improving asthma control through telemedicine: a study of short-message service. *Telemedicine Journal and e-Health* 2005;**11**(1):28–35.

**Pal 1998**
Pal B, Taberner DA, Readman LP, Jones P. Why do outpatients fail to keep their clinic appointments? Results

from a survey and recommended remedial actions. *International Journal of Clinical Practice* 1998;**52**(6):436–7.

**Paul 1997**
Paul J, Hanna JB. Applying the marketing concept in health care: the no-show problem. *Health Marketing Quarterly* 1997;**14**(3):3–17. [MEDLINE: 16]

**Pesata 1999**
Pesata V, Pallija G, Webb AA. A descriptive study of missed appointments: families' perceptions of barriers to care. *Journal of Pediatric Health Care* 1999;**13**(4):178–82.

**Potamitis 1994**
Potamitis T, Chell PB, Jones HS, Murray PI. Non-attendance at ophthalmology outpatient clinics. *Journal of the Royal Society of Medicine* 1994;**87**(10):591–3.

**Ramm 2001**
Ramm C, Robinson S, Sharpe N. Factors determining non-attendance at a cardiac rehabilitation programme following myocardial infarction. *The New Zealand Medical Journal* 2001;**114**(1132):227–9.

**Reda 2010**
Reda S, Makhoul S. Prompts to encourage appointment attendance for people with serious mental illness. *Cochrane Database of Systematic Reviews* 2010, Issue 4. [DOI: 10.1002/14651858.CD002085]

**Reekie 1998**
Reekie D, Devlin H. Preventing failed appointments in general dental practice: a comparison of reminder methods. *British Dental Journal* 1998;**185**(9):472–4.

**Richardson 1998**
Richardson A. Failed appointments in an academic orthodontic clinic. *British Dental Journal* 1998;**184**(12): 612–5.

**Rodgers 2005**
Rodgers A, Corbett T, Bramley D, Riddell T, Wills M, Lin RB, et al.Do u smoke after txt? Results of a randomised trial of smoking cessation using mobile phone text messaging. *Tobacco Control* 2005;**14**(4):255–61.

**Ross 1995**
Ross JD, McIver A, Blakely A, Dalrymple J, Peacock W, Wallis C. Why do patients default from follow-up at a genitourinary clinic?: a multivariate analysis. *Genitourinary Medicine* 1995;**71**(6):393–5.

**Sawyer 2002**
Sawyer SM, Zalan A, Bond LM. Telephone reminders improve adolescent clinic attendance: a randomized controlled trial. *Journal of Paediatrics and Child Health* 2002;**38**(1):79–83.

**Sharp 2001**
Sharp DJ, Hamilton W. Non-attendance at general practices and outpatient clinics. *BMJ* 2001;**323**(7321):1081–2.

**Simmons 1997**
Simmons AV, Atkinson K, Atkinson P, Crosse B. Failure of patients to attend a medical outpatient clinic. *Journal of the Royal College of Physicians of London* 1997;**31**(1):70–3.

**Skaret 1998**
Skaret E, Raadal M, Kvale G, Berg E. Missed and cancelled appointments among 12-18-year-olds in the Norwegian Public Dental Service. *European Journal of Oral Sciences* 1998;**106**(6):1006–12.

**Skaret 2000**
Skaret E, Raadal M, Kvale G, Berg E. Factors related to missed and cancelled dental appointments among adolescents in Norway. *European Journal of Oral Sciences* 2000;**108**(3):175–83.

**Specht 2004**
Specht EM, Powell KR, Dormo CA. Factors affecting missed appointment rates for pediatric patients insured by medicaid in a traditional hospital-based resident clinic and hospital-owned practice settings. *Clinical Pediatrics* 2004; **43**(8):749–52.

**Thomas 2004**
Thomas D. Postal reminders can improve attendance at orthodontic clinics. *Evidence-Based Dentistry* 2004;**5**(1):14.

**van Baar 2006**
van Baar JD, Joosten H, Car J, Freeman GK, Partridge MR, van Weel C, et al.Understanding reasons for asthma outpatient (non)-attendance and exploring the role of telephone and e-consulting in facilitating access to care: exploratory qualitative study. *Quality and Safety in Health Care* 2006;**15**(3):191–5.

**Vernon 2003**
Vernon S. Families in poor socio-economic areas and mobile phones. *BMJ* 2003;**327**:564.

**Vilella 2004**
Vilella A, Bayas JM, Diaz MT, Guinovart C, Diez C, Simo D, et al.The role of mobile phones in improving vaccination rates in travelers. *Preventive Medicine* 2004;**38**(4):503–9.

**Vodafone 2004**
Vodafone text message pilot evaluation. Homerton University Hospital, NHS Foundation Trust. 2004.

**Vodopivec-Jamsek 2012 (in press)**
Vodopivec-Jamsek V, de Jongh T, Gurol-Urganci I, Atun R, Car J. Mobile phone messaging for preventive health care (in press). *Cochrane Database of Systematic Reviews* 2012. [DOI: 10.1002/14651858.CD007457]

**Waller 2000**
Waller J, Hodgkin P. Defaulters in general practice: who are they and what can be done about them?. *Family Practice* 2000;**17**(3):252–3.

**Weingarten 1997**
Weingarten N, Meyer DL, Schneid JA. Failed appointments in residency practices: who misses them and what providers are most affected?. *Journal of the American Board of Family Practice* 1997;**10**(6):407–11.

**Wikipedia 2007**
Wikipedia. Short Message Service. http://en.wikipedia.org/wiki/Short˙message˙service (accessed February 2007).

**Wogelius 2005**

Wogelius P, Poulsen S. Associations between dental anxiety, dental treatment due to toothache, and missed dental appointments among six to eight-year-old Danish children: a cross-sectional study. *Acta Odontologica Scandinavica* 2005;**63**(3):179–82.

**Yoon 2005**

Yoon EY, Davis MM, Van Cleave J, Maheshwari S, Cabana MD. Factors associated with non-attendance at pediatric subspecialty asthma clinics. *Journal of Asthma* 2005;**42**(7): 555–9.

**Zailinawati 2006**

Zailinawati AH, Ng CJ, Nik-Sherina H. Why do patients with chronic illnesses fail to keep their appointments? A telephone interview. *Asia-Pacific Journal of Public Health* 2006;**18**(1):10–5.

* *Indicates the major publication for the study*

## CHARACTERISTICS OF STUDIES

### Characteristics of included studies *[ordered by study ID]*

**Chen 2008**

| | |
|---|---|
| Methods | Study design: RCT.<br>Randomisation method: Computer generated.<br>Allocation concealment: Unclear.<br>Baseline comparability: Age and gender.<br>Blinding: No information of blinding of researchers provided. Blinding of participants not possible due to nature of intervention |
| Participants | China, Hospital Health Promotion Centre. 1891 adults (mean age 50.6 years, 57.6% male) who had scheduled appointments within 72 hours to 2 months from recruitment. 32 adults who failed to provide telephone numbers were excluded |
| Interventions | SMS group: Participants received text message reminders delivered through a mobile phone SMS, 72 hrs before appointment. The SMS was automatically sent through GSM model linked to the electronic health record system. The text message included participant's name and appointment details<br>Telephone group: Participants were called by the office medical assistants from the health promotion centre, 72 hrs before appointment. A maximum of three reminders were attempted in the telephone group. If the phone was unanswered, the participant would be called on their mobile phone number. Call content was the same as the SMS content<br>Control group: No reminders. |
| Outcomes | Attendance rate at the healthcare appointment.<br>Costs of reminders. |
| Notes | |

***Risk of bias***

| Bias | Authors' judgement | Support for judgement |
|---|---|---|
| Random sequence generation (selection bias) | Low risk | Computer generated random numbers |
| Allocation concealment (selection bias) | Unclear risk | Not stated |
| Blinding (performance bias and detection bias)<br>All outcomes | Unclear risk | No information of blinding of researchers provided. Blinding of participants not possible due to nature of intervention. Unlikely to influence outcome measures |
| Incomplete outcome data (attrition bias)<br>All outcomes | Low risk | 11 participants could not be contacted by telephone or SMS as they changed their numbers or there was incorrect recording of the phone numbers by the medical assis- |

| | | |
|---|---|---|
| | | tant. The reason for loss-to-follow up is due to the nature of the intervention and the numbers are small in comparison to sample size |
| Selective reporting (reporting bias) | Unclear risk | Protocol is not available, however, the number of possible outcomes seems restricted to those reported |
| Other bias | Low risk | Control and intervention groups are similar at baseline and no other apparent source of bias are identified |

**Fairhurst 2008**

| | |
|---|---|
| Methods | Study design: RCT.<br>Randomisation method: Random sequence of numbers<br>Allocation concealment: "[S]ealed opaque numbered envelopes. One of two trained designated receptionists randomised each appointment by sequentially opening the sealed envelopes and allocating the appointment to the intervention group or the control group as indicated."<br>Baseline comparability: Age and gender.<br>Blinding: No information of blinding of researchers provided. Blinding of participants not possible due to nature of intervention |
| Participants | Scotland. Innercity general practice. 415 appointments made by 173 participants who had failed to attend two or more routine appointments in the preceding year. Same day appointments and participants with no mobile phones numbers were excluded |
| Interventions | SMS group: Participants received text message reminders delivered through a mobile phone SMS. The text message was sent between 8:00-9:00 on the morning preceding afternoon appointments, and between 16:00-17:00 on the afternoon preceding morning appointments. Texts were sent from a PC using www.vodafone.net<br>Control group: No reminders. |
| Outcomes | Non-attendance rate. |
| Notes | |

***Risk of bias***

| **Bias** | **Authors' judgement** | **Support for judgement** |
|---|---|---|
| Random sequence generation (selection bias) | Low risk | A random sequence of labels. The randomisation sequence was based on table of random numbers |

**Fairhurst 2008** (*Continued*)

| | | |
|---|---|---|
| Allocation concealment (selection bias) | Low risk | "[S]ealed opaque numbered envelopes. One of two trained designated receptionists randomised each appointment by sequentially opening the sealed envelopes and allocating the appointment to the intervention group or the control group as indicated |
| Blinding (performance bias and detection bias)<br>All outcomes | Unclear risk | No information of blinding of researchers provided. Blinding of participants not possible due to nature of intervention. Unlikely to influence outcome measures |
| Incomplete outcome data (attrition bias)<br>All outcomes | Low risk | Three appointments had to be excluded due to incorrect recording of the appointment date. 25 out of 191 text messages in the intervention group were not successfully delivered |
| Selective reporting (reporting bias) | Low risk | Protocol is available and the study's prespecified outcomes have been reported |
| Other bias | High risk | As the unit of analysis is appointment rather than individual participant who may have more than one appointment in the study period, there is clustering of data. There is also the assumption that the timing of the reminder will not influence the outcome |

**Koury 2005**

| | |
|---|---|
| Methods | Study design: RCT.<br>Randomisation method: Unclear.<br>Allocation concealment: Unclear.<br>Baseline comparability: Age and gender.<br>Blinding: No information of blinding of researchers provided. Blinding of participants not possible due to nature of intervention |
| Participants | UK. Six randomly-selected ENT clinics in one district general hospital. 441 participants who were scheduled to attend the selected clinics were eligible. Participants who could not be contacted by telephone, who were not familiar with SMS and those not wishing to participate in the study were excluded. 291 participants were included in the study |
| Interventions | SMS group: All participants received postal reminders two weeks before appointment. Intervention group also received text message reminders 24 hours before appointment. Texts were sent through a web-based provider<br>Control group: Postal reminder two weeks before appointment only |

**Koury 2005** (*Continued*)

| | |
|---|---|
| Outcomes | Attendance rate.<br>Proportion of participants willing to be contacted by SMS (before the intervention) |
| Notes | |

***Risk of bias***

| **Bias** | **Authors' judgement** | **Support for judgement** |
|---|---|---|
| Random sequence generation (selection bias) | Unclear risk | No information on the method of randomisation. |
| Allocation concealment (selection bias) | Unclear risk | Not stated. |
| Blinding (performance bias and detection bias)<br>All outcomes | Unclear risk | No information of blinding of researchers provided. Blinding of participants not possible due to nature of intervention. Unlikely to influence outcome measures |
| Incomplete outcome data (attrition bias)<br>All outcomes | Low risk | There is no loss to follow up. |
| Selective reporting (reporting bias) | Unclear risk | Protocol is not available, however the number of possible outcomes seems restricted to those reported |
| Other bias | Unclear risk | The authors state that the groups were comparable at baseline, although no data are provided |

**Leong 2006**

| | |
|---|---|
| Methods | Study design: RCT.<br>Randomisation method: Block randomisation.<br>Allocation concealment: Unclear.<br>Baseline comparability: Age, gender, income, reason for follow-up, whether the participant is the patient or the caregiver<br>Blinding: Research assistants were blinded to the intervention. Participants couldn't be blinded due to the nature of the intervention |
| Participants | Malaysia. Seven primary care clinics. 993 participants whose follow-up appointments fell between 48 hours to 3 months from recruitment date. Either the patients or their caregivers had to have a mobile phone with text messaging function |
| Interventions | SMS group: Participants received text message reminders delivered through a mobile phone SMS, 24 to 48 hrs before appointment. The text message included participant's name and appointment details<br>Mobile phone group: Participants were called 24 to 48 hrs before appointment. A maxi- |

| | |
|---|---|
| | mum of three reminders was attempted in the intervention groups. Call content was the same as the SMS content<br>Control group: No reminders. |
| Outcomes | Attendance rate at the healthcare appointment.<br>Costs of reminders. |
| Notes | |

***Risk of bias***

| **Bias** | **Authors' judgement** | **Support for judgement** |
|---|---|---|
| Random sequence generation (selection bias) | Low risk | Block randomisation method using software. |
| Allocation concealment (selection bias) | Low risk | The researcher who did the randomisation was not involved in patient recruitment and intervention |
| Blinding (performance bias and detection bias)<br>All outcomes | Low risk | Research assistants were blinded to the intervention. Participants couldn't be blinded due to the nature of the intervention |
| Incomplete outcome data (attrition bias)<br>All outcomes | Low risk | Between 9 to 11 participants in each group did not receive the allocated intervention due to incorrect assignments by researchers. They were included in the intention-to-treat analysis |
| Selective reporting (reporting bias) | Unclear risk | Protocol is not available, however, the number of possible outcomes seems restricted to those reported |
| Other bias | High risk | The definition of 'attendance' is strict, being attendance at the clinics on scheduled days. The participants in the study were not accustomed to healthcare appointments but rather walk-in visits: 48% of the participants actually visited the clinic on days other than the appointment dates<br>The control and intervention groups were comparable at baseline |

## Characteristics of excluded studies *[ordered by study ID]*

| Study | Reason for exclusion |
|---|---|
| Bos 2005 | Study design: Cohort study |
| Car 2008 | Study design: Review |
| Downer 2005 | Study design: Cohort study with historical control |
| Geraghty 2008 | Study design: Cohort study with historical control |
| Koshy 2008 | Study design: Cohort study |
| Kruse 2009 | Study design: Cohort study |
| Milne 2006 | Study design: Cohort study |

## DATA AND ANALYSES

### Comparison 1. Mobile phone text message reminders vs no reminders

| Outcome or subgroup title | No. of studies | No. of participants | Statistical method | Effect size |
|---|---|---|---|---|
| 1 Attendance rate at healthcare appointments | 3 | 2313 | Risk Ratio (M-H, Random, 95% CI) | 1.10 [1.03, 1.17] |

### Comparison 2. Mobile phone message text reminders plus postal reminders vs postal reminders

| Outcome or subgroup title | No. of studies | No. of participants | Statistical method | Effect size |
|---|---|---|---|---|
| 1 Attendance rate at healthcare appointments | 1 | 291 | Risk Ratio (M-H, Fixed, 95% CI) | 1.10 [1.02, 1.19] |

### Comparison 3. Mobile phone message reminders vs phone call reminders

| Outcome or subgroup title | No. of studies | No. of participants | Statistical method | Effect size |
|---|---|---|---|---|
| 1 Attendance rate at healthcare appointments | 2 | 1887 | Risk Ratio (M-H, Random, 95% CI) | 0.99 [0.95, 1.03] |

## Analysis 1.1. Comparison 1 Mobile phone text message reminders vs no reminders, Outcome 1 Attendance rate at healthcare appointments.

Review: Mobile phone messaging reminders for attendance at healthcare appointments

Comparison: 1 Mobile phone text message reminders vs no reminders

Outcome: 1 Attendance rate at healthcare appointments

| Study or subgroup | SMS reminders n/N | No reminders n/N | Risk Ratio M-H,Random,95% CI | Weight | Risk Ratio M-H,Random,95% CI |
|---|---|---|---|---|---|
| Chen 2008 | 538/615 | 498/619 | | 51.4 % | 1.09 [ 1.04, 1.14 ] |
| Fairhurst 2008 | 167/189 | 187/226 | | 33.8 % | 1.07 [ 0.99, 1.16 ] |
| Leong 2006 | 194/329 | 161/335 | | 14.8 % | 1.23 [ 1.06, 1.42 ] |
| **Total (95% CI)** | **1133** | **1180** | | **100.0 %** | **1.10 [ 1.03, 1.17 ]** |

Total events: 899 (SMS reminders), 846 (No reminders)

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 3.50$, df = 2 (P = 0.17); $I^2 = 43\%$

Test for overall effect: Z = 3.05 (P = 0.0023)

Test for subgroup differences: Not applicable


## Analysis 2.1. Comparison 2 Mobile phone message text reminders plus postal reminders vs postal reminders, Outcome 1 Attendance rate at healthcare appointments.

Review: Mobile phone messaging reminders for attendance at healthcare appointments

Comparison: 2 Mobile phone message text reminders plus postal reminders vs postal reminders

Outcome: 1 Attendance rate at healthcare appointments

| Study or subgroup | SMS n/N | Postal reminders n/N | Risk Ratio M-H,Fixed,95% CI | Weight | Risk Ratio M-H,Fixed,95% CI |
|---|---|---|---|---|---|
| Koury 2005 | 135/143 | 127/148 | | 100.0 % | 1.10 [ 1.02, 1.19 ] |
| **Total (95% CI)** | **143** | **148** | | **100.0 %** | **1.10 [ 1.02, 1.19 ]** |

Total events: 135 (SMS), 127 (Postal reminders)

Heterogeneity: not applicable

Test for overall effect: Z = 2.44 (P = 0.015)

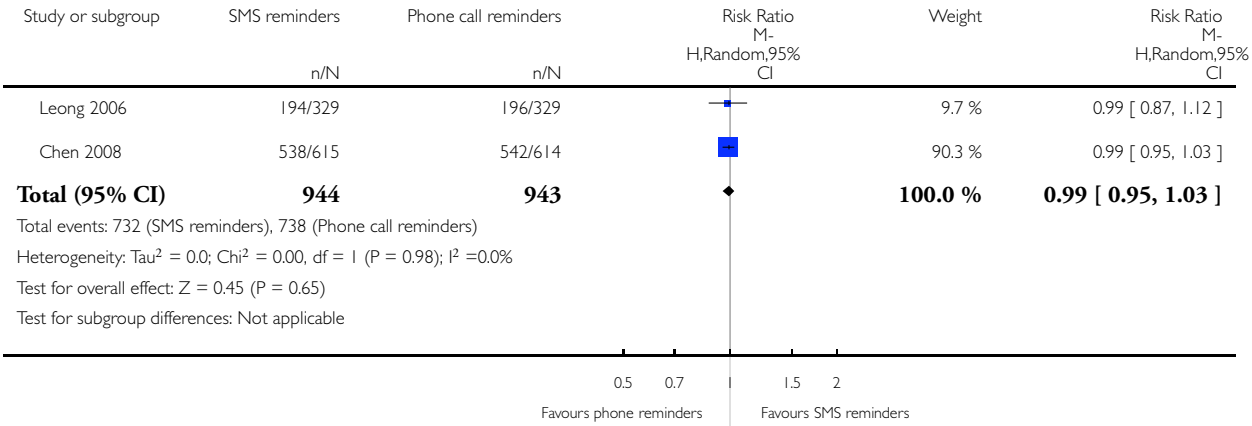
Test for subgroup differences: Not applicable

**Analysis 3.1. Comparison 3 Mobile phone message reminders vs phone call reminders, Outcome 1 Attendance rate at healthcare appointments.**

Review: Mobile phone messaging reminders for attendance at healthcare appointments

Comparison: 3 Mobile phone message reminders vs phone call reminders

Outcome: 1 Attendance rate at healthcare appointments




## ADDITIONAL TABLES

**Table 1. Characteristics of communication modes**

| | Face-to-face | Postal Letter | Call to Landline | Call to Mobile | Web Based (EHR) | Email | SMS / MMS |
|---|---|---|---|---|---|---|---|
| Immediacy | Slow: Requires a visit to provider | Slow: 2 days | Immediate: If person at home. Return call may be necessary | Immediate: If person answers (more likely than landline) Return call may be necessary Immediate | Immediate: | Immediate Or stored | Immediate Or stored |

**Table 1. Characteristics of communication modes** (*Continued*)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Privacy and Confidentiality | High: Personal communication | High: Personally addressed | Low: Confidentiality prevents message being left as others may answer or retrieve it | High: Personal device enables possibility of message being left | Moderate: Personal / public device? | Moderate: Personal / public device? | High if Personal device |
| Likelihood of misinterpretation | Low | Moderate | Low: Patient can request immediate clarification | Low: Patient can request immediate clarification | Moderate | Moderate | Moderate |
| Delivery confirmation | N/A | Yes: at significant expense | Unnecessary if call answered. No if message left | Unnecessary if call answered. No if message left | N/A | Yes | Yes |
| Cost | High | Moderate | Low | Moderate | Low | Low | Low |

**Table 2. Secondary outcomes data**

| Study | Costs and cost effectiveness (monetary unit as specified in the study) | Participant evaluation of the intervention (as reported in the study) | Potential harms or adverse effects of the intervention (as reported in the study) |
|---|---|---|---|
| Chen 2008 | ***Cost per attendance:*** SMS group: 0.31 Yuan (4.7 GBP) Telephone group: 0.48 Yuan (7.3 GBP) ***Ratio of total cost per attendance:*** SMS group: 0.65 (relative to telephone group) | | |
| Koury 2005 | | 98% willing to receive routine reminders of their appointments: Usefulness of the intervention: • 62% thought it would be useful • 31% doubted its value • 7% were unsure | |
| Leong 2006 | ***Cost per attendance:*** SMS group: 0.45 RM (0.67 GBP) Mobile phone group: 0.82 RM (0.123 GBP) ***Ratio of total cost per attendance:*** SMS group: 0.55 (relative to mobile | | No adverse events reported during the study period. |

**Table 2. Secondary outcomes data** (*Continued*)

| | | | |
|---|---|---|---|
| | phone group) | | |

# APPENDICES

## Appendix 1. MEDLINE (Ovid) search strategy

1. cellular phone/
2. text messag$.ab,ti.
3. texting.ab,ti.
4. short messag$.ab,ti.
5. sms.ab,ti.
6. (multimedia messag$ or multi-media messag$).ab,ti.
7. mms.ab,ti.
8. ((cellular phone$ or cell phone$ or mobile phone$) and (messag$ or text$)).ab,ti.
9. or/1-8
10. randomized controlled trial.pt.
11. controlled clinical trial.pt.
12. randomized controlled trials.sh.
13. random allocation.sh.
14. double blind method.sh.
15. single blind method.sh.
16. or/10-15
17. animals/ not (human/ and animals/)
18. 16 not 17
19. clinical trial.pt.
20. exp clinical trials/
21. (clin$ adj25 trial$).ti,ab.
22. ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).ti,ab.
23. placebos.sh.
24. placebo$.ti,ab.
25. random$.ti,ab.
26. research design.sh.
27. or/19-26
28. 27 not 17
29. 18 or 28
30. exp evaluation studies/
31. follow up studies/
32. prospective studies/
33. (control$ or prospectiv$ or volunteer$).tw.
34. cross over studies/
35. comparative study/
36. or/30-35
37. experiment$.tw.
38. (time adj series).tw.
39. (pre test or pretest or (posttest or post test)).tw.

40. (pre intervention or preintervention or (post intervention or postintervention)).tw.
41. (impact$ or intervention$ or chang$ or outcome$).tw.
42. effect$.tw.
43. or/37-42
44. 36 and 43
45. animals/ not (human/ and animals/
46. 44 not 45
47. 29 or 46
48. 47 and 9
49. limit 48 to yr="1993 - 2008"

## Appendix 2. EMBASE (Ovid) search strategy

1. mobile phone/
2. wireless communication/
3. (cellular phone* or cellular telephon* or cell phone* or mobile phone* or mobile telephon* or wireless phone* or wireless telephon*).ti.
4. 1 or 2 or 3
5. limit 4 to abstracts
6. (cellular phone* or cellular telephon* or cell phone* or mobile phone* or mobile telephon* or wireless phone* or wireless telephon*).tw.
7. (text* or messag* or multimedia or multi-media or imag* or data or input* or sms or mms).tw.
8. (5 or 6) and 7
9. 4 not 5
10. (text messag* or texting or texted).tw.
11. (short messag* or (sms not (somatostatin* or sphingomyelin*))).tw.
12. (multimedia messag* or multi-media messag*).tw.
13. (mms and (multimedia or multi-media)).tw.
14. or/8-13
15. Randomized Controlled Trial/
16. random*.tw.
17. experiment*.tw.
18. time series.tw.
19. (pre test or pretest or post test or posttest).tw.
20. impact.tw.
21. intervention*.tw.
22. chang*.tw.
23. evaluat*.tw.
24. effect?.tw.
25. compar*.tw.
26. control*.tw.
27. or/15-26
28. nonhuman/
29. 27 not 28
30. 14 and 29
31. limit 30 to yr="1993-2009"

## Appendix 3. PsycINFO (Ovid) search strategy

1. (cellular phone* or cellular telephon* or cell phone* or mobile phone* or mobile telephon* or wireless phone* or wireless telephon*).tw.
2. (text* or messag* or multimedia or multi-media or imag* or data or input* or sms or mms).tw.
3. 1 and 2
4. (text messag* or texting or texted).tw.
5. (short messag* or sms).tw.
6. (multimedia messag* or multi-media messag*).tw.
7. (mms and (multimedia or multi-media)).tw.
8. or/3-7
9. random*.tw.
10. experiment*.tw.
11. trial.tw.
12. placebo.ab.
13. groups.ab.
14. ((singl* or doubl* or trebl* or tripl*) and (blind* or mask*)).tw.
15. time series.tw.
16. time series/
17. (pre test or pretest or post test or posttest).tw.
18. (pre intervention or preintervention or post intervention or postintervention).tw.
19. (cross over or crossover).tw.
20. latin square.tw.
21. (prospective* or volunteer*).tw.
22. impact.tw.
23. intervention*.tw.
24. chang*.tw.
25. evaluat*.tw.
26. effect?.tw.
27. compar*.tw.
28. control*.tw.
29. treatment effectiveness evaluation/
30. mental health program evaluation/
31. exp experimental design/
32. or/9-31
33. limit 32 to human
34. limit 33 to yr="1993-2008"
35. (health* or medic* or telemedic* or patient* or illness* or therap* or psychiatr* or nurs* or remind* or consult*).tw.
36. ("27" or "32" or "33" or "34").cc.
37. 35 or 36
38. 8 and 34
39. 38 and 37

## Appendix 4. CENTRAL search strategy

#1 "cellular phone":kw or "mobile phone":kw or ((text next messag*) or texting or texted or (short next messag*) or (sms not (somatostatin* or sphingomyelin*)) or (multimedia next messag*) or (multi-media next messag*) or (mms and (multimedia or multi-media)) or (cellular next phone*) or (cellular next telephon*) or (cell next phone*) or (mobile next phone*) or (mobile next telephon*) or (wireless next phone*) or (wireless next telephon*)):ti,ab in Clinical Trials

#2 human*:kw in Clinical Trials

#3 #1 and #2

## Appendix 5. CINAHL (EBSCO) search strategy

| | |
|---|---|
| S15 | s14 |
| S14 | S10 or S13 |
| S13 | s11 and s12 |
| S12 | PT Research |
| S11 | S3 not S10 |
| S10 | s3 and s9 |
| S9 | S4 or S5 or S6 or S7 or S8 |
| S8 | pre test or pretest or post test or posttest or pre intervention or preintervention or post intervention or postintervention or time series |
| S7 | TI ((singl* or doubl* or trebl* or tripl*) and (blind* or mask*)) or AB ((singl* or doubl* or trebl* or tripl*) and (blind* or mask*)) |
| S6 | random* or trial or groups or placebo* or experiment* or control* or compar* or intervention* or chang* or evaluat* or impact* or effect? |
| S5 | PT Clinical Trial |
| S4 | MH Experimental Studies+ or MH Random Assignment or MH Comparative Studies or MH Comparative Studies or MH Crossover Design or MH Placebos or MH Quantitative Studies or MH Quasi-Experimental Studies+ |
| S3 | S1 or S2 |
| S2 | cellular phone* or cellular telephon* or cell phone* or mobile phone* or mobile telephon* or wireless phone* or wireless telephon* or text messag* or texting or texted or short messag* or sms or multimedia messag* or multi-media messag* or (mms and (phone* or telephon* or multimedia or multi-media or messag*)) |
| S1 | MH Wireless Communications |

## Appendix 6. African Health Anthology search strategy

1 - Query 1:

| | |
|---|---|
| KEY WORDS/PHRASES | RANDOM* OR TRIAL* OR CONTROL* OR PROSPECTIV* OR VOLUNTEER* OR EXPERIMENT* OR TIME SERIES OR PRE TEST OR PRETEST OR POST TEST OR POSTTEST OR PRE INTERVENTION OR PREINTERVENTION OR POST INTERVENTION OR POSTINTERVENTION OR IMPACT* OR INTERVENTION* OR CHANG* OR EFFECT* |
| TITLE | PLACEBO OR GROUPS |

(*Continued*)

| | |
|---|---|
| INDEX TERMS | RESEARCH DESIGN OR FOLLOW UP STUDIES OR PROSPECTIVE STUDIES OR CROSS OVER STUDIES OR DRUG THERAPY |

2 - Query 2:

| | |
|---|---|
| KEY WORDS/PHRASES | ((TEXT* OR MESSAG* OR MULTIMEDIA OR MULTI-MEDIA OR IMAG* OR DATA OR INPUT* OR SMS OR MMS) AND (CELLULAR PHONE* OR CELLULAR TELEPHON* OR CELL PHONE* OR MOBILE PHONE* OR MOBILE TELEPHON* OR WIRELESS PHONE* OR WIRELESS TELEPHON*)) OR TEXT MESSAG* OR TEXTING OR TEXTED OR SHORT MESSAG* OR (SMS NOT (SOMATOSTATIN* OR SPHINGOMYELIN*)) OR MULTIMEDIA MESSAG* OR MULTI-MEDIA MESSAG* OR (MMS AND (MULTIMEDIA OR MULTI-MEDIA) ) |
| TITLE | CELLULAR PHONE* OR CELLULAR TELEPHON* OR CELL PHONE* OR MOBILE PHONE* OR MOBILE TELEPHON* OR WIRELESS PHONE* OR WIRELESS TELEPHON* |
| INDEX TERMS | CELLULAR PHONE |

3 - Query 1 and Query 2.

### Appendix 7. Search Strategy for LILACS, trial portals and grey literature

"cellular phone" OR "mobile phone" OR cellular telephone* OR mobile telephone* OR text messag* OR texting OR texted OR short messag* OR multimedia messag* OR sms OR mms

## HISTORY

Protocol first published: Issue 4, 2008

Review first published: Issue 7, 2012

## CONTRIBUTIONS OF AUTHORS

Josip Car conceived the review together with Rifat Atun. He is the contact author for the reviews and coordinated all stages of the study, including the protocol stage. He advised on designing the search strategy, screening search results against inclusion criteria, and appraising quality of the papers. He assisted in interpreting the data and contributed to writing the review, providing clinical and consumer perspectives and will be responsible for any update of this review.

Ipek Gurol-Urganci developed the protocols. She has led the search process and assisted in screening the papers. She collected, analysed, interpreted the data and contributed to writing the review, providing methodological and policy perspectives.

Vlasta Vodopivec Jamsek developed the protocols. She has been involved in data extraction and management. She led the screening and quality appraisal process and assisted in undertaking searches. She has collected, analysed and interpreted the data and contributed to writing the review, providing clinical and consumer perspectives.

Thyra de Jongh coordinated data extraction and management and was involved in the screening and quality appraisal process. She has collected, analysed and interpreted the data and contributed to writing the review, providing a methodological perspective.

Rifat Atun provided strategic guidance and contributed to writing of the review.

## DECLARATIONS OF INTEREST

None declared.

## SOURCES OF SUPPORT


### Internal sources

- eHealth Unit, Department of Primary Care and Social Medicine, Imperial College, UK.
salaries, office space
- Centre for Health Management, Tanaka Business School, Imperial College, UK.
salaries, office space
- Department of Family Medicine, Faculty of Medicine, University of Ljubljana, Slovenia.
salaries, office space
- Imperial College London, UK.
salaries, office space
- London School of Hygiene and Tropical Medicine, UK.
salaries, office space

### External sources

- Ministry of Higher Education, Science and Technology, Slovenia.
grant funding


## DIFFERENCES BETWEEN PROTOCOL AND REVIEW

### Search strategy

We were not able to search the following databases we listed in the protocol:

- Proceedings from the MEDNET Congresses: We could not access the proceedings.

- TrialsCentralTM (www.trialscentral.org): The website for the data base was not functional and did not allow for the search of clinical trials.

- African Trials Register: The trials in the African Trials Register are collected with a search strategy using the Cochrane Controlled Trials Register and the African Health Anthology (AHA). As we search both original sources, it was not necessary to access the African Trials Register separately.

- Health Star: The database ceased to exist as of December 2000, with all peer-reviewed journal articles transferred to PubMed.

## INDEX TERMS

### Medical Subject Headings (MeSH)

*Appointments and Schedules; *Reminder Systems [economics]; *Text Messaging [economics]; Cellular Phone; Randomized Controlled Trials as Topic

### MeSH check words

Humans