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RESEARCH ARTICLE

How Effective Are Short Message Service Reminders at Increasing Clinic Attendance? A Meta-Analysis and Systematic Review

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Background and Objectives. In the last few years there has been a steady uptake of mobile phone short message service (SMS) reminders to increase medical attendance rates. We undertook a review of studies that assessed the effectiveness of SMS reminders at increasing the uptake of appointments in health care settings.

Methods. We reviewed studies which involved a comparison of appointment attendance rates between patients who did and did not receive SMS reminders published prior to June 2010. We used meta-analysis methods to calculate the overall effect on attendance rates, stratified by study design and clinic type.

Results. The review criteria were met by 18 reports, made up of eight randomized controlled trials (RCTs) and 10 controlled observational studies. Across all studies, there was significant heterogeneity in the estimated effect measure of the relationship between use of SMS reminders and clinic attendance (I^2 = 90 percent; $p < .01$), so a summary effect estimate was not calculated. Stratification by study design showed that the heterogeneity was due to the observational studies. The summary effect from the RCTs was 1.48 (95% CI: 1.23–1.72) with no significant subgroup differences by clinic type (primary care clinics, hospital outpatient clinics), message timing (24, 48, and 72 + hours before the scheduled appointment), and target age group (pediatric, older).

Conclusions. Short message service reminders in health care settings substantially increase the likelihood of attending clinic appointments. SMS reminders appear to be a simple and efficient option for health services to use to improve service delivery, as well as resulting in health benefits for the patients who receive the reminders.

Key Words. Reminder systems, appointment, health services, review

Nonattendance at clinical appointments is a major problem for health systems, as it increases costs and reduces the efficiency of service delivery (Atun, Sittampalam, and Mohan 2005; Downer, Meara, and Da Costa 2005). In the

United Kingdom, nonattendance at outpatient clinics costs the National Health Service an estimated £790 million per year (Atun, Sittampalam, and Mohan 2005).

Nonattendance may also be linked to adverse health outcomes for the people who miss their appointments (Nelson, Maruish, and Axler 2000; Karter et al. 2004; Schectman, Schorling, and Voss 2008). Psychiatric patients who had been hospitalized were found to be more than twice as likely to be readmitted if they failed to attend follow-up appointments, compared with those who did attend (Nelson, Maruish, and Axler 2000). People with diabetes who missed appointments had significantly poorer glycemic control after adjusting for sociodemographic factors and number of primary care visits (Karter et al. 2004; Schectman, Schorling, and Voss 2008).

The most commonly reported reasons for nonattendance are as follows: forgetting, competing employment and family commitments, poor health, poor patient–provider relationships, and adverse clinical experiences (Martin, Perfect, and Mantle 2005; Neal et al. 2005; van Baar et al. 2006; Crosby et al. 2009). To reduce nonattendance, health services have implemented reminder systems via telephone or post. These approaches have been shown to be effective at increasing attendance rates (Henderson 2008) but involve considerable staff time (Chen et al. 2008). More recently, there has been a move to the use of mobile phone short message service (SMS) reminders, also known as text message reminders, to encourage attendance, or notification of inability to attend the appointment (Martin, Perfect, and Mantle 2005).

Short message service reminders are appealing because of the wide penetration of mobile phones in many countries (Milne, Horne, and Torsney 2006) as well as the directness, convenience, immediacy, and confidentiality of text messaging. Text messaging can also be linked to technology that allows large numbers of messages to be sent simultaneously and automatically, thereby reducing labor costs compared with telephone or postal reminder systems (Chen et al. 2008). Chen et al. (2008), in a trial of reminder methods to

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increase attendance rates, found that although SMS reminders and telephone reminders were equally effective, SMS was more cost-effective.

Over the past 5 years, there have been a number of studies that evaluated the effectiveness of SMS reminders, either using observational or randomized designs. In this review, we examine the effectiveness of SMS reminders at increasing attendance rates.

METHODS

We conducted a literature search of all published and unpublished reports that reported on the use of SMS reminders to increase clinic attendance rates. Attendance was defined as attending an appointment that had been prearranged.

Review Process

A report was considered if it described the impact of SMS reminders on increasing attendance rates or decreasing nonattendance rates in a health care facility, and we compared it with attendance or nonattendance in a control group which did not receive any form of reminder.

The electronic bibliographic databases Medline and Embase were searched; in addition, the Cochrane Controlled Trials Register (The Cochrane Library) and Google search engine were searched, and results prior to June 2010 were included. Both English and non-English papers were included. Reference lists of selected studies were also checked for other potentially relevant studies. Conference presentations were included if the corresponding full report was not available. If the required information was not available in the report or conference presentation, authors were contacted for unpublished data.

The following key terms were used in the searches:

- Texting or text message or text messaging or SMS or SMS-based system or SMS reminder or SMS or text reminder and
- Attendance or attend or nonattendance or appointment or failed appointment or no-shows or show rate.

The abstracts of potentially eligible papers were screened and full manuscript was reviewed for those that met the inclusion criteria.

The papers were reviewed and information was extracted by two authors independently. Disagreements were resolved by discussion and consensus.

Papers were excluded if they described electronic communication systems other than SMS reminders; reported on attendance rates without an intervention; involved programs to improve health outcomes other than attendance rates; or if original data were not reported.

For each paper that met inclusion criteria, information was extracted on the clinic type and location, the target population, the type of clinical service for which the appointment had been made, the timing and content of the SMS reminder, the evaluation study design, the sample size, statistical tests used, the outcomes of the evaluation including nonattendance rates, and attendance rates.

Analysis

We conducted a frequency analysis of information related to the clinic (location, type), intervention (SMS reminder timing and content), and evaluation methods (sample size, design, analytical techniques, time period of the evaluation and reported outcomes).

The primary outcome for each study was the attendance rate defined as proportion of patients attending their appointment at the originally scheduled time, in both the group receiving SMS reminders and the controls. From each study, we either abstracted or calculated the odds ratio (OR) of the attendance rate in the text message group compared with controls, as the primary effect measure for the study. If papers presented nonattendances rates as the primary outcome, we converted them to attendance rates by subtracting the number of nonattendances from the total number of patients and then dividing by all patients.

If a paper presented data from individual clinics but did not present a combined result, we calculated the overall study effect estimate by summing the total attendances from the individual clinics and dividing them by the sum of the number receiving SMS reminders or the controls.

To examine evidence for publication and small study biases, we used funnel plots of log OR against trial size (measured by standard error of the log risk ratio). Where appropriate, we pooled data using meta-analysis. We used the I^2 test to estimate the approximate proportion of total variability in point estimates that could be attributed to heterogeneity other than that due to chance (Higgins et al. 2003). We pooled data, depending on the level of between trial heterogeneity, as follows:

- $I^2 < 25$ percent: we used fixed effects meta-analysis to estimate the common OR (95% CI), assuming that all or most between trial variability was due to chance;
- I^2 25–75 percent: used random effects meta-analysis (DerSimonian and Laird 1986) to estimate the average OR (Riley, Jiggins, and Deeks 2011);
- $I^2 > 75$ percent: heterogeneity too great for summary estimate to be calculated.

We explored possible reasons for heterogeneity by stratifying study results by study design (randomized versus observational studies), clinic type (primary care clinics and hospital outpatient clinics), message timing (24, 48, and 72+ hours before the scheduled appointment), and target age group (pediatric, adult, older). The age classification was based on the median age of the patient receiving the SMS reminders, or the specification of the clinic type as pediatric.

Meta-analysis was performed in *STATA 10* (StataCorp, College Station, TX, USA).

RESULTS

Using the search words, 53 articles were identified. Of these, 23 were excluded based on abstract because they described a survey of attendance rates (Martin, Perfect, and Mantle 2005; van Baar et al. 2006; Brown et al. 2006, 2008; Casey et al. 2007; Hogan et al. 2008; Hogg, Lomicky, and Weiner 2008; Crosby et al. 2009; O'Connor et al. 2009; Raine et al. 2009); were reviews or commentaries which did not contain original data (Reda and Makhoul 2001; Callaghan 2003; Fahey 2003; Tomlinson 2003; Car et al. 2008; Cohen et al. 2008; Henderson 2008; Krishna, Boren, and Balas 2009); described programs to improve health outcomes other than attendance rates (Mao, Zhang, and Zhai 2008; Miloh et al. 2009; Shapiro et al. 2010; Pijnenborg et al. 2010); or described electronic communication systems that did not use SMS reminders to improve attendance rates (Zingmond and Lenert 1993; Oddsson et al. 2009).

Of the remaining 30 articles, the full manuscript was read and 12 others were excluded for the following reasons: SMS was used by patients only to book appointments and not for appointment reminders (Neville et al. 2008); there was no control group (Menon-Johansson et al. 2006; Warwick, Dean,

and Carter 2007; Lim, Haar, and Morgan 2008); the attendance rates were calculated for all patients rather than only those receiving the SMS reminders (Jones 2005; Lewis 2009); the paper did not have sufficient data to calculate an OR (Martin, Perfect, and Mantle 2005; Battistotti, Quaglini, and Cuoco 2006; Bowen and Dewar 2008; Mackenzie 2009); or the paper did not contain any data (Dyer 2003; Donaldson and Tayar 2009).

The remaining 18 papers (Bos, Hoogstraten, and Prahl-Andersen 2005; Downer, Meara, and Da Costa 2005; Downer et al. 2006; Leong et al. 2006; Milne, Horne, and Torsney 2006; Chen et al. 2008; Fairhurst and Sheikh 2008; Geraghty et al. 2008; Koshy, Car, and Majeed 2008; Nair, Butt, and Baguley 2008; da Costa et al. 2009; Foley and O'Neill 2009; Fung et al. 2009; Kruse, Hansen, and Olesen, 2009; Liew et al. 2009; Cho et al. 2010; Macpherson and Alpsten 2010; Stott 2009) were included in the review. These papers were published between 2006 and 2010 (median = 2008) and related to data collection between 2004 and 2008 (median = 2006) (Table 1). One paper was translated from Danish to English by the author of the paper for the purpose of this review.

The interventions represented a wide variety of countries, most in Europe, but also including Malaysia, China, Brazil, the United States, and Australia (Table 1).

Clinics were mainly outpatient clinics of hospital (10 of 18) and primary health services (6 of 18). The 10 outpatient clinics saw patients for pediatrics (five), ophthalmology (one), orthodontics (one), genitourinary medicine (one), and preventative health (one) and for two papers it was not specified (Table 1). Of the five pediatric clinics, two were specialist services (dentistry and ear nose and throat), two were in a variety of specialist areas, and for one the specialty was not specified (Table 1). Eleven papers described findings for single clinics, and the remaining papers for clinics.

The median number of appointments where a SMS reminder was sent was 440 (range: 16–22,658) over an average evaluation time period of 4.5 months (range: 4 days to 97 months). The median number of appointments where a SMS reminder was not sent (controls) was 442 (range: 15–22,454).

In seven papers, the SMS reminders targeted patients attending pediatrics clinics or a youth health service. In pediatric settings, the SMS reminder was sent to the young patient or their parent/carer, in the study by Stott (2010). SMS reminders were sent directly to the young people. In two other papers, the target population were adults (mean age of 38 years, mean age of 33 years). In four papers, the target group was older (mean age of

Table 1: Summary of SMS Interventions by Clinic Type, Intervention, and Evaluation Design ($n = 18$)

Area	*Category*	*Subcategory*	*All Interventions*
Clinic	Locations ($n = 18$)	United Kingdom	4 (22.2)
		Australia	3 (16.7)
		Scotland	2 (11.1)
		Malaysia	2 (11.1)
		Ireland	1 (5.6)
		United States	1 (5.6)
		Denmark	1 (5.6)
		Brazil	1 (5.6)
		Korea	1 (5.6)
		Netherlands	1 (5.6)
		China	1 (5.6)
	Clinic type ($n = 18$)	Hospital outpatient clinic	10 (55.6)
		Primary care clinic	6 (33.3)
		Youth health service	1 (5.6)
		Red Cross Blood Bank	1 (5.6)
	Pediatric hospital ($n = 5$) outpatient specialties	Dentistry	1 (20.0)
		Ear, nose, throat (ENT)	1 (20.0)
		Various*	2 (40.0)
		Not specified	1 (20.0)
	Number of clinics ($n = 18$)	1	11 (61.1)
		4–7	5 (27.8)
		19	1 (5.6)
		120	1 (5.6)
Intervention	Year published ($n = 18$)	Median (range)	2006 (2004–2010)
	SMS timing before appointment ($n = 18$)	≤ 24†	10 (55.6)
		24–48	2 (11.1)
		48	1 (5.6)
		72	4 (22.2)
		8 weeks before appt	1 (5.6)
	Content of message ($n = 18$)	General	13 (72.2)
		Personalized	3 (16.7)
		Not specified	2 (11.1)
Evaluation	Design ($n = 18$)	RCT—blinded‡	2 (11.1)
		RCT—nonblinded	6 (31.6)
		Observational with concurrent control	5 (27.8)
		Observational with historical control	5 (27.8)
	Months in evaluation analysis ($n = 18$)	Median (range)	4.5 (0.1–9.7)

continued

Table 1. *Continued*

Area	*Category*	*Subcategory*	*All Interventions*
	Reported outcome ($n = 18$)	Nonattendance rate	9 (50.0)
		Attendance	9 (50.0)
	Number of patients in SMS group ($n = 18$)	Median (range)	440 (16–22,658)
	Number of patients in control group ($n = 18$)	Median (range)	442 (15–22,452)

*Downer, Meara, and Da Costa (2005): Dermatology, gasteronterology, general medicine, paedatric dentistry, plastic surgery; Kruse, Hansen, and Olesen (2009): dermatology, gastroenterology, general medicine, dentistry, plastic surgery.
†Koshy, Car, and Majeed (2008): SMS was sent 24 hours before the appointment if it was booked within 7 and 4 days before if it was booked more than 7 days in advance.
‡Blinded = recruiters or investigators blinded to the allocation of intervention when recruiting patients.
RCT, randomized controlled trial; SMS, short message service.

58 years, mean age of 50 years, aged 50–70 years, and 68 percent were >50 years) and in five others, the age of the target group was not specified.

The SMS reminders sent were mostly generic (13 of 18 papers), reminding patients of their appointments at the clinic at a specified date and time and the clinic. Three other studies used personalized messages which included the name of the patient (see Box 1 for examples). In two papers, the content of the message was not specified.

BOX 1: EXAMPLES OF SMS CONTENT

Generic message

This is a reminder of your appointment at Barts and the London Hospital at time, date, Please call xxx or reply to text to cancel

or

This is a reminder about your appt. If you need to cancel, please call us on xxxxx

Personalized message

Hi NAME. How r u? Just a reminder that yr appointment with WORKER is at #pm tomorrow. C u then! If you can't make it pls call Youthblock Health on 95162233 (Stott 2010).

Table 2: Findings of SMS Interventions to Increase Attendance ($n = 18$)

Study Number	*References*	*Clinic Type*	*Outpatient Clinic Type*	*Target Age Group**	*Evaluation Design*	*Total Appointments (n)*	*Intervention Group Size and % Attended*		*Control Group Size and % Attended*		*Odds Ratio Calculated by Reviewer (95% CI)*
							n	*%*	*n*	*%*	
1	Liew et al. (2009)	PCC		Older (mean age = 58)	RCT blinded†	617	308	84.4	309	77.0	1.62 (1.06–2.48)
2	Cho et al. (2010)	PCC		Older (68% >50 years)		624	327	76.1	297	72.4	1.48 (1.02–2.14)
3	Bos, Hoogstraten, and Prahl-Andersen (2005)	HOC	Orthodontic	NS	RCT nonblinded	143	51	82.4	92	83.7	0.91 (0.34–2.57)
4	Chen et al. (2008)	HOC	Preventative health	Older (mean age = 50)		1,239	620	87.5	619	80.5	1.69 (1.23–2.34)
5	Fairhurst and Sheikh (2008)	PCC		Adult (mean age = 33)		415	189	88.3	226	83.0	1.53 (0.84–2.84)
6	Fung et al. (2009)	RCBB		NS		31	16	56.2	15	40.0	1.93 (0.37–10.18)

continued

Table 2. *Continued*

Study Number	*References*	*Clinic Type*	*Outpatient Clinic Type*	*Target Age Group**	*Evaluation Design*	*Total Appointments (n)*	*Intervention Group Size and % Attended*		*Control Group Size and % Attended*		*Odds Ratio Calculated by Reviewer (95% CI)*
							n	*%*	*n*	*%*	
7	Kruse, Hansen, and Olesen (2009)	HOC	Pediatrics	Younger		1,027	478	94.1	549	90.0	1.79 (1.09–2.98)
8	Leong et al. (2006)	PCC		Adult (mean age = 38)		664	329	59.0	335	48.1	1.55 (1.13–2.14)
9	Milne, Horne, and Torsney (2006)‡	HOC	Pediatrics	Pediatric	Observational with concurrent control	16,399	2,651	88.1	13,748	84.6	1.34 (1.18–1.53)
10	Koshy, Car, and Majeed (2008)‡	HOC	Ophthalmology	NS		9,959	447	75.4	9,512	71.2	1.24 (0.99–1.56)
11	Macpherson and Alpsten (2010)	PCC		Older (aged 50–70 years)		4,764	491	73.0	4,273	47.0	3.03 (2.45–3.77)
12	da Costa et al. (2009)§	PCC		NS		29,014	7,890	85.1	21,124	70.0	2.45 (2.29–2.62)
13	Stott (2010)	PCC-YHS		Pediatric (12–24 years)		362	183	64.7	179	57.1	1.21 (0.78–1.88)

continued

Table 2. *Continued*

Study Number	*References*	*Clinic Type*	*Outpatient Clinic Type*	*Target Age Group**	*Evaluation Design*	*Total Appointments (n)*	*Intervention Group Size and % Attended*		*Control Group Size and % Attended*		*Odds Ratio Calculated by Reviewer (95% CI)*
							n	*%*	*n*	*%*	
14	Downer et al. (2006)	HOC	Pediatrics	Pediatric	Observational with	45,110	22,658	90.2	22,452	80.5	2.23 (2.11–2.36)
15	Downer, Meara, and Da Costa (2005)	HOC	Pediatrics	Pediatric	historical control	2,864	1,382	85.8	1,482	76.6	1.85 (1.52–2.25)
16	Foley and O'Neill (2009)	HOC	Pediatrics	Pediatric		709	433	83.8	276	76.1	1.63 (1.1–2.42)
17	Geraghty et al. (2008)	HOC	Pediatrics	Pediatric		8,966	3,981	78.0	4,985	66.4	1.79 (1.63–1.98)
18	Nair, Butt, and Baguley (2008)	HOC	Genitourinary medicine	NS		204	148	80.4	56	71.4	1.64 (0.75–3.50)

*Based on reported mean age of those who received the text messages, or if not available the type of clinic (pediatric).
†Recruiters /investigators blinded to the allocation of intervention.
‡The study reported a significant OR for nonattendance. However, when we calculated the RR for attendance it was nonsignificant. This occurred as the SMS reminders affected cancellations disproportionately to attendances.
§RR was calculated by summing the total attendances from the individual clinics and dividing by the sum of the number receiving SMS reminders or the controls.
HOC, hospital outpatient clinic; NS, not specified; PCC, primary care clinic; RCBB, Red Cross Blood Bank; RCT, randomized controlled trial; SMS, short message service; YHS, youth health service.

Reminders were most commonly delivered <24 hours prior to the appointment (10 papers), followed by 24–48 or 48 hours (three), in four others it was 72 hours prior to the appointment, and in one it was 8 weeks before the appointment. The reminder at 8 weeks prior to the appointment was also to remind the patient about medication adherence.

The randomized control trials (RCTs) included two studies in which recruiters or investigators were blinded to the allocation of intervention, and six studies where they were not blinded. There were 10 observational studies, with control groups that did not receive SMS reminders; five of which had concurrent controls and five used historical controls. One of the controlled observational studies matched controls by age, gender, language spoken at home, and the number of workers the young person saw at the health service; and the recruiters were blinded to the allocation of intervention.

The reported main outcome in nine papers was the nonattendance rate, whereas for other nine papers it was the attendance rate. Of the 10 observational studies, eight used a two-sample comparison of proportions to determine whether there was a significant difference between the intervention and control groups (Table 1) while for the remaining two no statistical test was reported but the authors mentioned that they plan to conduct a quantitative analysis in the next few months. Only one of the 10 observational studies reported utilizing a statistical approach, which accounted for the clustering of patients within clinics (Table 1). Of the seven RCTs, three specified that they had used an intention to treat approach.

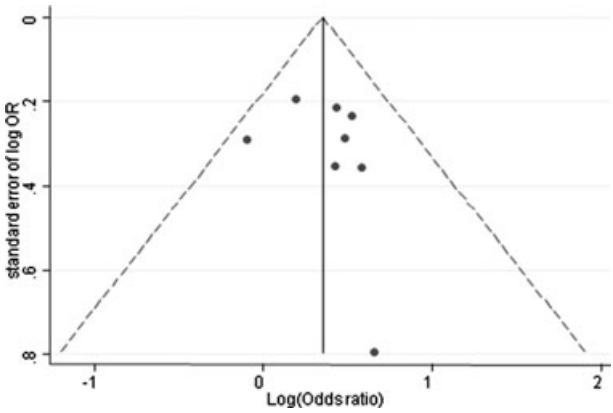
Meta-Analysis

For 17 studies we calculated an OR and for one study we used the OR presented in the paper as it was based on a multivariate analysis.

The use of SMS reminders to increase attendance, evaluated with RCTs or observational studies, was associated with an I^2 of 90 percent ($p < .01$). As this result indicated significant heterogeneity, we did not calculate the summary effect estimate. Upon stratification by study design, it appeared that the heterogeneity was largely due to the observational studies, from which the use of SMS reminders to increase attendance among was associated with an I^2 of 94 percent ($p < .01$), as compared to 0.0 percent ($p = .84$) among the RCTs (Figure 2). On this basis, the meta-analysis was restricted to RCTs.

The funnel plots for RCTs showed no evidence of publication bias (Figure 1).

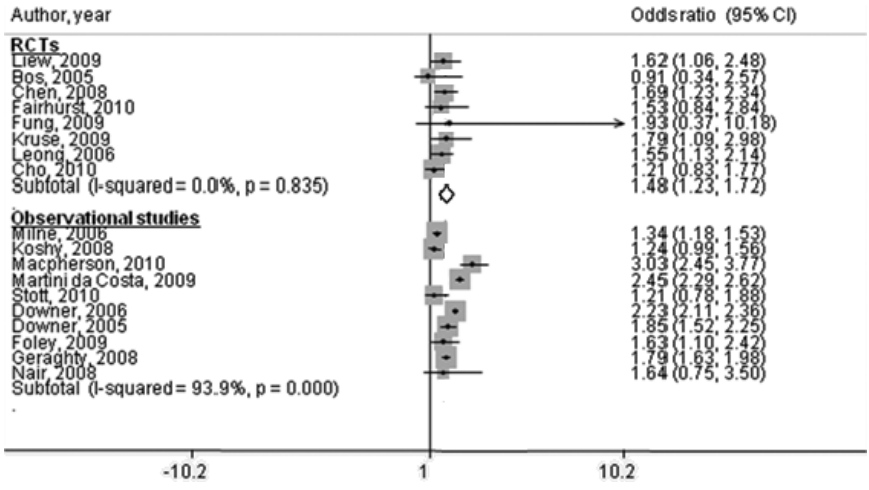
Figure 1: Funnel Plot for Studies on Effect of Short Message Service (SMS) Interventions on Attendance, Randomized Controlled Trials (RCTs) Only ($n = 8$)



RCTs

The use of SMS reminders to increase attendance, evaluated with RCTs, was associated with a summary OR under the fixed model of 1.48 (95% CI: 1.33–1.72) (Figure 2) with no significant subgroup differences by clinic type (primary care clinics and hospital outpatient clinics) message timing (24, 48, and

Figure 2: Meta-Analysis of Short Message Service (SMS) Interventions to Increase Attendance, by Study Type



72+ hours before the scheduled appointment) and target age group (pediatric, older).

DISCUSSION

This systematic review has found combined evidence from RCTs that the use of SMS reminders increases the likelihood of attendance at clinical appoints by 50 percent, compared to no appointment reminder. The effect of was similar in both primary care and hospital outpatient clinics.

The RCTs also demonstrated that SMS reminders were effective in a wide age range from pediatric to older. Mobile phone usage data demonstrate that over 90 percent of the population in many countries own mobile phones, but the uptake is higher in younger people (Milne, Horne, and Torsney 2006). As younger patients have been shown to have higher nonattendance rates at clinical services (Neal et al. 2005), then the use of SMS reminders may be more beneficial in this group. On the other hand, older patients have considerable more health appointments each year, and often at outpatient clinics where nonattendance costs the National Health Service an estimated £790 million per year (Atun, S, and Mohan 2005).

There is evidence from two papers included in this review (Fairhurst and Sheikh 2008; Stott 2010) that these trials may have overestimated the benefit of SMS for individual appointments, if repeat attendances were included in analyses. Patients in the SMS group would be more likely to attend their appointment, creating a greater opportunity for them to attend a subsequent appointment; if a patient in the control group failed to attend the first appointment, there may not have been another opportunity.

Our review has some methodological limitations. First, although we searched the gray literature it is still possible that some evaluations were not identified, particularly those with a negative outcome. Second, we were unable to assess the possibility of an effect according to the clinical reasons for attending, as few papers presented this information. Clinical presentation could affect the priority placed by patients on the need for keeping an appointment. To maximize the value of future evaluations, studies should collect and report information on the clinical reason for attendance as well as the visit status (new, follow up).

This review shows that SMS reminders have value in reducing nonattendance rates in a wide variety of settings and thereby provide a simple and efficient option for health services to improve service delivery. The increase in

attendance should result in health benefits for the patients who receive the reminders. Thus, SMS reminders deserve further attention as a potential innovation to improve health care operations.

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Appendix SA1: Author Matrix.

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