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SYSTEMS-LEVEL QUALITY IMPROVEMENT

The Effectiveness of SMS Reminders on Appointment Attendance: a Meta-Analysis

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Abstract To identify the efficacy of short message service (SMS) reminders in health care appointment attendance. A systematic review was undertaken to identify studies published between 2005 and 2015 that compared the attendance rates of patients receiving SMS reminders compared to patients not receiving a reminder. Each article was examined for information regarding the study design, sample size, population demographics and intervention methods. A meta-analysis was used to calculate a pooled estimate odds ratio. Twenty-eight (28) studies were included in the review, including 13 (46 %) randomized controlled trials. The pooled odds ratio of the randomized control trials was 1.62 (1.35–1.94). Half of the studies reviewed sent the reminder within 48 h prior to the appointment time, yet no significant subgroups differences with respect to participant age, SMS timing, rate or type, setting or specialty was detectable. All studies, except one with a small sample size, demonstrated a positive OR, indicating SMS reminders were an effective means of improving appointment attendance. There was no significant difference in OR when controlling for when the SMS was sent, the frequency of the reminders or the content of the reminder. SMS appointment reminders are an effective and operative method in improving appointment attendance in a health care setting and this effectiveness has improved over the past 5 years. Further research is required to identify the optimal SMS reminder timing and frequency, specifically in relation to the length of time since the appointment.

Keywords Appointment · Efficacy · Meta-analysis · Reminder systems · SMS

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Background

The non-attendance is defined as when a patient does not attend their scheduled appointments. This non-attendance has financial and human resources implications, leading to inefficiency in health care delivery. The United Kingdom (UK) National Health Services reported a loss of approximately £790 million during 1 year due to non-attendance for scheduled appointments [1]. It is estimated non-attendance represents approximately 6.5 % of all appointments, which can result in underutilization of health care professional time, extended appointment waiting times and impacting overall on the efficacy of the health care system [2, 3]. Non-attendance results in a delay in patients presenting with symptoms, loss of

time in diagnosis and treatment, and decreased monitoring of long-term chronic conditions. This may increase the risk of hospitalization or a worsening of an existing condition. For example, significantly poorer glycemic control was seen in patients with diabetes who miss their appointments, after adjusting for confounders [4].

Multiple studies have investigated the causes of non-attendance, reporting forgetfulness, competing work or family related commitments, poor health, poor patient-provider relationships, adverse clinical experiences, practice error and patient confusion over dates and times as the most frequent causes of non-attendance [5–7]. Some of these causes could potentially be averted, particularly practice error and patient confusion over dates and times, if a reminder service had been implemented.

In recent years, health services have been trialing short message services (SMS) reminders for appointment attendance. SMS or texting using mobile phones, was introduced in the early 1990s. The advantage of SMS reminders are they are delivered almost instantly, are available in many countries, are less intrusive and more convenient than the traditional telephone call, and can be sent in large batches to multiple numbers by automated software, thereby reducing labor cost [8]. As mobile phone popularity increases, the potential to use SMS reminders in healthcare management increases [9]. Furthermore, SMS communication is one of the most widely used forms of communication in various countries, with the Office of National Statistics reporting over 85 % of the population in the UK use mobile phones [9]. Studies that have compared the cost of sending a reminder via traditional methods, such as a telephone call or postal, compared to using SMS technology have found SMS reminders to be cheaper and more cost effective [10]. Many industries, such as banking, entertainment and advertising, have already implemented SMS technology utilization into their business practice [11].

A review of the published literature on a meta-analysis of effectiveness of SMS reminders for appointment attendance only identified three studies, which analyzed articles published up to July 2010 [12], September 2010 [13] and February 2011 [14]. These studies reported a moderate to good level of effectiveness of SMS technology in appointment reminders and attendance. Given the increased uptake of technology by both consumers and healthcare organizations over the past 4 years, a meta-analysis that includes more recent findings was deemed necessary to inform healthcare organizations of the value of SMS appointment reminders in health care service delivery. This article presents the findings of this meta-analysis. This study adopted the methods utilized by Guy and colleagues [12] as it was the only published meta-analysis that examined the odds ratio of attendance, allowing a comparison of the results from this meta-analysis to that reported by Guy and colleagues. The major difference to Guy's study was the journal databases examined, as this study identified other sources that may capture a greater number of scholarly articles. This study also only examined published literature that had been through a peer review process to ensure the quality and validity of the study had been assessed. The objective of this meta-analysis was to identify if SMS reminders are still an effective means of reducing appointment non-attendance, and if this effectiveness has improved, measured as an increased odds ratio, since the analysis reported by Guy and colleagues.

Materials and methods

The databases Medline via OvidSP, PubMed, EMBASE and CINAHL were searched on 22 March 2015 using the keywords: "texting" OR "text reminder" OR "text messaging" AND "reminder systems" OR "SMS reminder" AND "attendance" OR "appointments and schedules" AND "non-attendance" OR "failed appointment. The inclusion criteria for articles were those which (1) evaluate a SMS reminder intervention against a control group (no reminder) for a healthcare appointment, (2) written in or translated to the English language, (3) scholarly journal article with full text available, and (4) published between January 2005 and January 2015. Articles were excluded from consideration if they: (1) examined a technology other than SMS reminders, (2) examined attendance without a SMS reminder intervention, and (3) did not examine the impact on attendance rates. No authors were contacted for missing information or clarification.

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [15] for article selection (not analysis), articles were obtained utilizing the search strategy outlined above and duplicate articles from different database searches were excluded. In order to reduce researcher bias, the author, journal, institution and country where the research was conducted for each article was removed (where possible) by the second author of this paper. Each article title was reviewed by authors one and three of this paper independently, by order of publication date (newest to oldest) and using the eligibility criteria as the guiding selection framework. The two authors then underwent a moderation exercise to ensure they were applying the same process to article selection. The abstracts of the remaining papers were examined against the eligibility criteria by the two authors, again independently. Lastly, the full text of each remaining article was then reviewed and again assessed against the eligibility criteria. There was 100 % agreement in the final article selection between the two authors, demonstrating the article selection and moderation process was successful in reducing researcher bias. These articles were then reviewed by the other two authors of this paper to ensure they met the eligibility

criteria. During article analysis, the reference list of selected articles were examined for other articles that met the eligibility criteria. Throughout the process the reason for rejecting an article was documented. Figure 1 shows the article selection process.

For articles that were selected to be included in this review, pertinent information relating to the study design, randomization, sample size, target population, country, follow-up, outcome, attendance rate, specialty, type of service and SMS timing was extracted for analysis. A frequency analysis was conducted in relation to country, clinic setting, specialty, SMS timing, rate and message type, and study design. The primary outcome was attendance rate, defined as the percentage of patients attending their scheduled appointment. In studies that reported non-attendance rate, the attendance rate was calculated. The odds ratio (OR) and 95 % confidence interval (CI) for each study was then calculated if not reported and the data was published comparing an intervention group that received a SMS reminder against a control group that did not receive any reminder of the appointment. For studies that involved more than one service center, the results were pooled into one attendance rate and point estimate.

Using a modified version of a quality scoring rubric tested and reported by Hasvold and Wootton [14], each study was assessed against the following criteria: study size (0 = not stated; 1 = 1–100; 2 = 101–1000; 3 = 1001–10000; 4 = >10000), duration of intervention (0 = duration not stated; 1 = 1–3; 2 = 4–12; 3 = >12 months), study design (0 = not stated; 1 = retrospective controls; 2 = before and after, or non-randomized control trial; 3 = randomized control trial [RCT]), reported sample size of control and intervention group (0 = not stated; 1 = reported only for intervention group; 2 = reported for control and intervention group), and reported attendance rate or percentage (0 = not stated; 1 = only in intervention group; 2 = for both control and intervention group). This allowed a possible total out of 14.

The statistical heterogeneity, or variability in the intervention effects due to confounding variables, needed to be determined to identify between-study variability in order to pool their results for meta-analysis. To examine point estimate heterogeneity, I^2 was used. Random variable estimate was used when I^2 was moderate (I^2 between 25 and 75). If I^2 was greater than 75, no meta-analysis was conducted since heterogeneity was too large for a pooled estimate. The possible causes of heterogeneity were also investigated. Point estimates were stratified relative to variables: message timing (less than 24, 24 to 48 h, more than 48 h), number of text messages sent (1, 2, 3 and more), type of service (primary care clinic and outpatient clinic) and type of specialty. Meta-analysis was conducted using a previously reported, comprehensive meta-analysis design [16].

Results

Using the above search strategy, twenty-eight (28) articles were selected for inclusion in the meta-analysis. . These 28 studies included 13 (46 %) randomized controlled trials (RCT), five of which were single blinded. The remaining 15 (53 %) studies were observational, five of which had concurrent controls while the other ten had historical controls. The main reported outcome of all studies was non-attendance rate. These studies represented a wide variety of countries, with six (21 %) of studies conducted in England, four (14 %) in Australia, four (14 %) in Scotland and four (14 %) in the

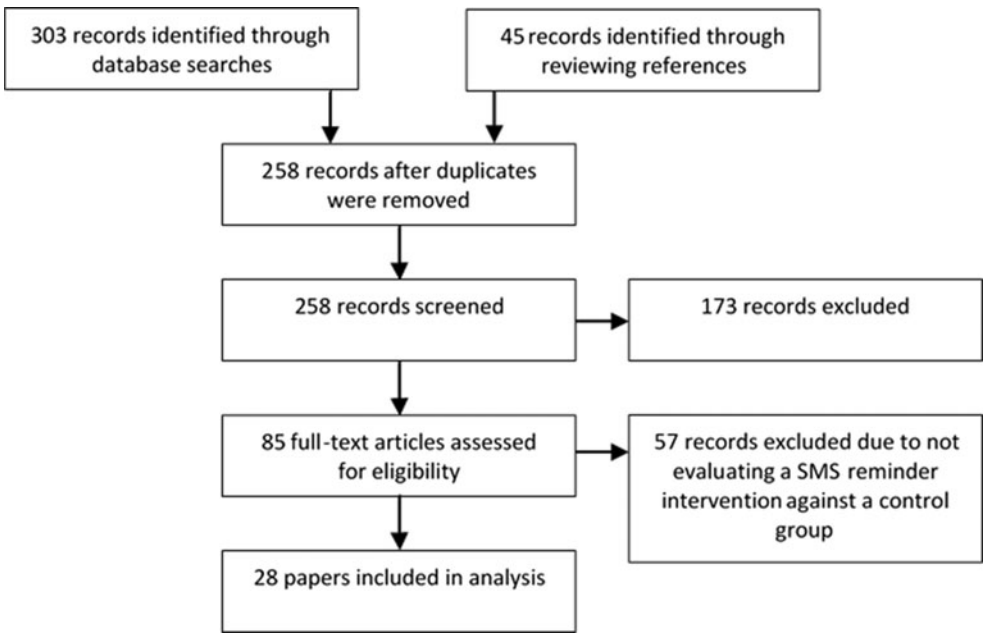

Fig. 1 Article selection process

Table 1 Characteristics of analyzed studies

Category	Subcategory	Number (%)	Subcategory	Number (%)
Country	England	6 (21 %)	Denmark	1 (4 %)
	Australia	4 (14 %)	India	1 (4 %)
	Scotland	4 (14 %)	Ireland	1 (4 %)
	United States	4 (14 %)	Korea	1 (4 %)
	Malaysia	2 (7 %)	Netherlands	1 (4 %)
	Brazil	1 (4 %)	Saudi Arabia	1 (4 %)
	China	1 (4 %)		
Setting	Hospital Outpatient Clinic	22 (79 %)		
	Primary Care Clinic	5 (18 %)		
	Red Cross Blood	1 (4 %)		
Specialty	Multiple	6 (21 %)	ENT	1 (4 %)
	Pediatric	4 (14 %)	Family Practice	1 (4 %)
	Dental[a]	4 (14 %)	Genitourinary	1 (4 %)
	Preventive Medicine	3 (11 %)	Physical therapy	1 (4 %)
	Ophthalmology	2 (7 %)	Urology	1 (4 %)
	Psychiatry	2 (7 %)	Not reported	1 (4 %)
	Chronic Disease	1 (4 %)		

%, percentage; ENT, Ears, Nose and Throat

[a] includes one clinical for pediatric dentistry

United States of America. Three types of healthcare settings were identified, with hospital outpatient clinics (79 %) the most commonly reported setting. SMS messaging was trialed in 25 different specialties, with pediatric (14 %) and dental (including pediatric) (14 %) the most frequently reported specialties. Seventy-five percent (75 %) of SMS appointment reminders were sent within 48 h before the appointment time, with the majority of studies (75 %) only sending one SMS reminder. Most (88 %) SMS reminder messages were a generic message. Two studies examined the cost-effectiveness of using SMS technology for appointment reminders. Characteristics of each study was extracted and summarized in Tables 1, 2 and 3.

Table 2 Frequency statistics for SMS reminder timing, rate and message type

Category	Subcategory	Number (%)
Time final SMS sent before appointment	≤24 h	7 (25 %)
	24–48 h	7 (25 %)
	>48	7 (25 %)
	Not reported	7 (25 %)
Number of SMS reminders sent	1	15 (54 %)
	2	3 (11 %)
	3	2 (7 %)
	>3	1 (4 %)
	Not reported	7 (25 %)
Message type	Generic	23 (82 %)
	Personal	3 (11 %)
	Not reported	2 (7 %)

% percent, *SMS* short message service

The heterogeneity of the observational studies (94 %, $p<0.001$) and all studies (95.21 %, $p<0.001$) (Fig. 2) was high, not allowing for a summary estimate. The heterogeneity of the RCT was moderate (60.83 %, $p=0.002$). The pooled effect of the RCT produced a positive effect for SMS reminders versus control with an OR of 1.62 (1.35–1.94) (Fig. 3). No significant subgroups differences with respect to participant age, SMS timing, rate or type, setting or specialty was detectable. The pooled effect of the articles published since July 2010 (articles published since those analyzed by Guy and colleagues [12]) could not be assessed due to the small sample size (12 articles). The funnel plot (For RCT only) shows that not publication bias in relation to size was noted (Fig. 4).

The quality score measured the strength of the study design with a possible maximum score of 14. The overall quality score was moderate (median 9.5) for the RCT studies. The quality score for the observational studies was also moderate (median 9). Although overall the observational studies scored lower on the rubric for study design, many of these studies reported larger sample sizes and longer observational periods of time than the RCT.

Discussion

The use of SMS appointment reminders is increasing in healthcare, as is the use of mobile applications for appointment

Table 3 Study statistics and odds ratio estimate of analyzed studies

Author (year)[Reference]	Time last SMS sent before appointment	Reported age statistics (years)	Control group		Intervention group		Odds ratio (95 % CI)
			N	Attendance %	N	Attendance %	
Randomized controlled trial / blinded							
Kerrison (2015) [17]	48 h	47–53	1118	59.1	1122	64.4	1.25 (1.06–1.48)
Odeny (2012) [18]	Daily for 7 days	Median = 24.9	356	59.7	387	65.4	1.27 (0.94–1.71)
Taylor (2012) [19]	24–48 h	Mean = 37.5	337	84.0	342	89.0	1.53 (0.98–2.38)
Cho (2010) [20]	NR	NR	297	72.4	327	76.1	1.48 (1.01–2.16)
Liew (2009) [11]	24–48 h	Mean = 58	309	77.0	308	84.4	1.62 (1.08–2.43)
Randomized controlled trial / not blinded							
Arora (2015) [21]	7, 3 days & 24 h	Mean = 45.6	182	62.1	146	72.6	1.62 (1.01–2.59)
Prasad (2012) [22]	24–48 h	NR	110	35.5	96	79.2	6.92 (3.69–12.97)
Kruse (2009) [23]	NR	'Young'	549	90.0	478	94.1	1.79 (1.12–2.87)
Fung (2009) [24]	NR	NR	15	40.0	16	56.2	1.93 (0.46–8.05)
Chen (2008) [25]	72 h	Mean = 50	619	80.5	620	87.5	1.69 (1.24–2.31)
Fairhurst (2008) [26]	<24 h	Mean = 33	226	83.0	189	88.3	1.53 (0.87–2.70)
Leong (2006) [8]	24–48 h	Mean = 38	335	48.1	329	59.0	1.55 (1.14–2.11)
Bos (2005) [27]	24 h	NR	92	83.7	51	82.4	0.91 (0.32–2.57)
Observational study / concurrent control							
Kunigiri (2014) [28]	2 weeks and 48 h	18–65	893	72.0	155	80.0	1.56 (1.02–2.37)
McInnes (2014) [29]	5 days and 48 h	Mean = 55	NR	69.0	NR	75.0	NC
da Costa (2010) [30]	NR	NR	21,124	70.0	7,890	85.1	2.45 (2.29–2.62)
Koshy (2008) [31]	24 h or 4 days	NR	9,512	71.2	447	75.4	1.24 (0.99–1.56)
Milne (2006) [32]	NR	NR	13,748	84.6	2,651	88.1	1.34 (1.18–1.53)
Sims (2012) [33]	5 and 3 days	Mean 42–44	648	64.0	2169	73.5	1.75 (1.37–2.23)
Altuwaijri (2012) [34]	5, 3 days and 24 h	NR	NR	76.1	NR	80.2	NC
Brannan (2011) [35]	2 weeks	NR	NR	88.0	201	94.5	NC
Ellanti (2011) [36]	3 days	16–30	25,820	82.4	27,604	87.6	1.51 (1.44–1.58)
Perry (2011) [37]	NR	NR	150	69.0	150	86.0	2.72 (1.5–4.8)
Foley (2009) [9]	24 h	NR	276	76.1	433	83.8	1.63 (1.1–2.42)
Nair (2008) [38]	NR	NR	56	71.4	148	80.4	1.64 (0.75–3.5)
Geragthy (2008) [39]	3 days	NR	4,985	66.4	3,981	78.0	1.79 (1.63–1.98)
Downer (2006) [10]	3 days	NR	22,452	80.5	22,658	90.2	2.23 (2.11–2.36)
Downer (2005) [2]	3 days	NR	1,482	76.6	1,382	85.8	1.85 (1.52–2.25)

% percentage, *CI* confidence interval, *N* Number, *NC* Not calculated, *NS* Not reported, *SMS* Short Message Service

management and online appointment booking systems, yet a meta-analysis of their effectiveness in reducing appointment non-attendance has not been assessed since the review of the literature up until 2010 was published by Guy and colleagues and by Free and colleagues, and up to February 2011 by Hasvold and Wootton [12–14]. This meta-analysis of the RCT studies supports the use of SMS reminders to reduce the rate of appointment non-attendance. A pooled meta-analysis was not performed on the observational studies due to heterogeneity, but most studies had a positive odds ratio indicating beneficial effect of using SMS reminders. The small sample size may explain the negative OR in the study by Bos [27]. The studies by Taylor [19], Odeney [18], Fung [24], Fairhurst [26], and Nair [38] all reported a 95 % confidence interval across 1.00, which again may be due to the small sample size. It is recommended future research examining the use of SMS technology to reduce appointment non-attendance utilize a large, evenly distributed between controls and intervention group, sample size.

Age

Subgroup analysis did not show significant differences in relation to age, with SMS reminders effective across all age groups. Further research is required to identify if there is an effect based on age. Research shows that in most countries, younger people have a greater acceptance and uptake of

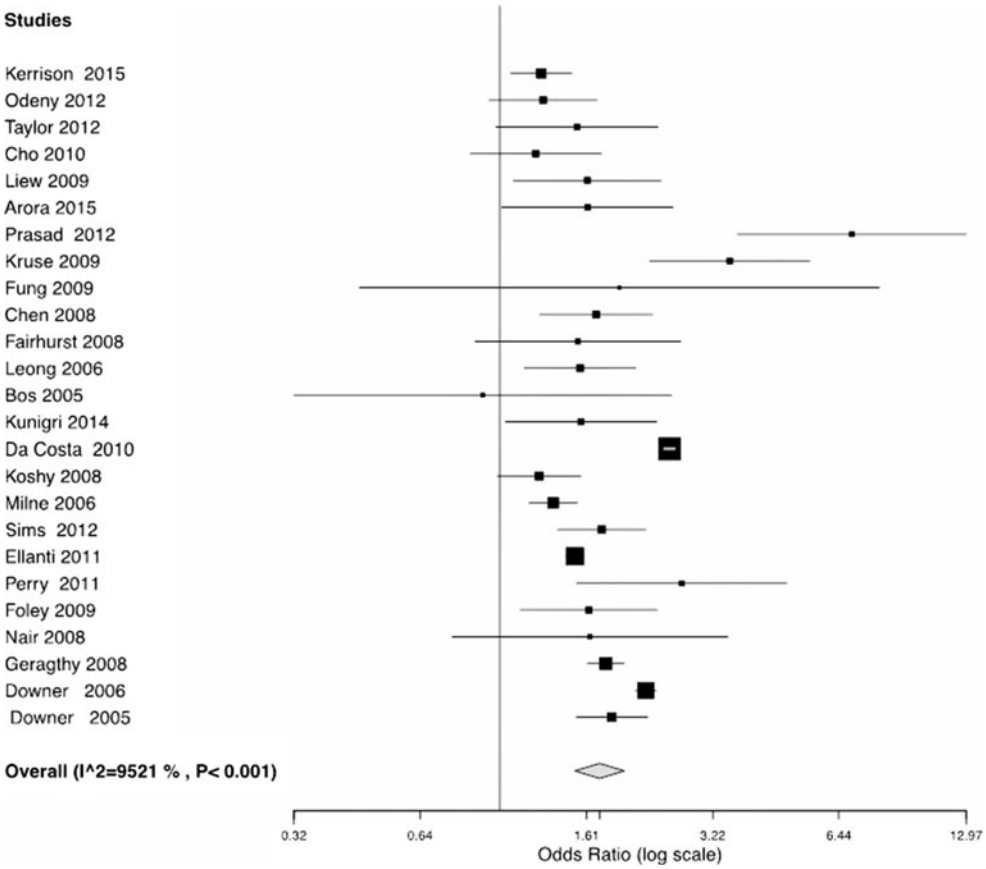

Fig. 2 Odds ratio for all studies

mobile phone technology and a lower attendance rate is noted in younger patients compared to the rest of the population [7, 32]. Moreover, research from the banking industry reports the older population prefer face-to-face interactions and are less likely to adopt new technologies [11]. This is supported by the finding that elderly people have the lowest percentage of mobile phone ownership, hindering the usability of SMS texting for this group [11]. Contrary to this, Koshy and colleagues reported that between 2001 and 2003 the greatest increase of mobile phone uptake was among those aged above 75 years [31]. This age group is also the highest user of health services.

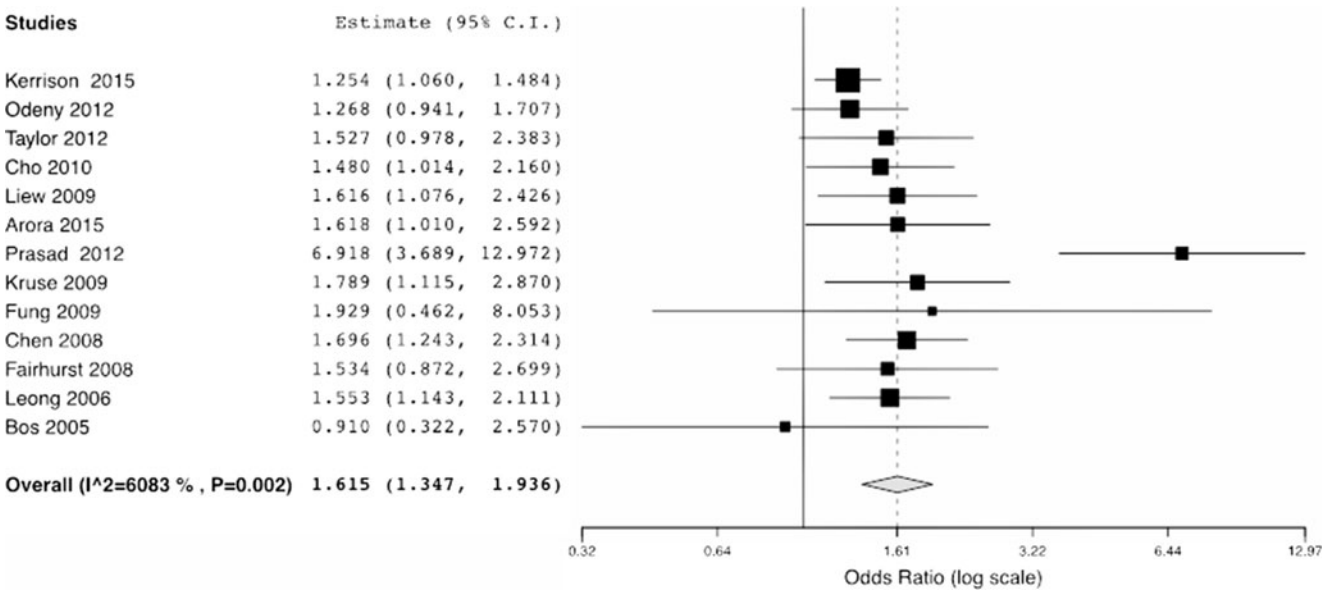

Fig. 3 RCT meta-analysis

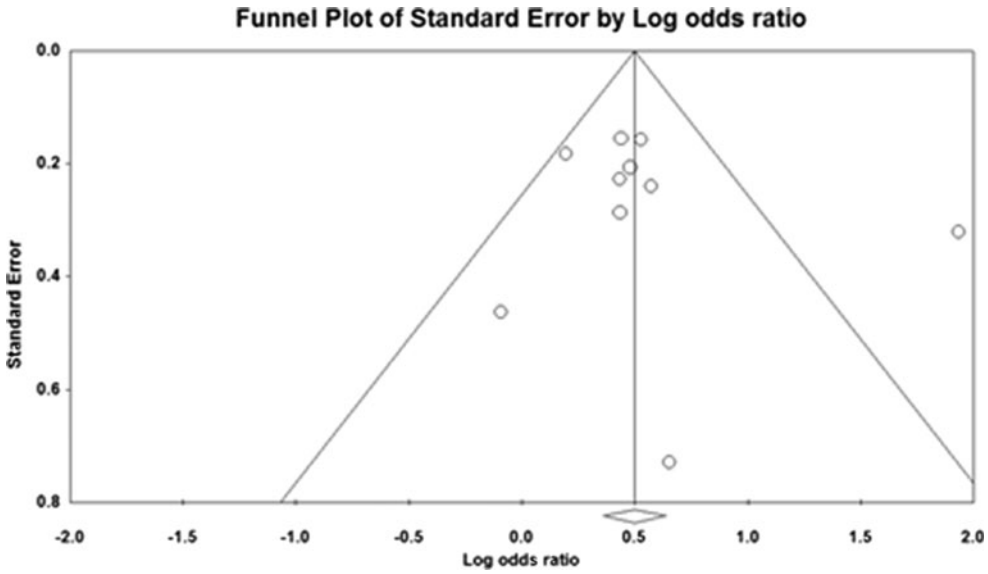

Fig. 4 Funnel plot

Clinic setting and specialty

Similarly, SMS reminders was shown to be effective in a range of healthcare settings and among different specialties, with no significant differences between each group. Further research should include subsets of patients for different conditions that may hinder their use of SMS reminders. Psychiatric patients with certain disorders such as depression or schizophrenia may respond better to a more personalized reminder.

SMS timing, rate and type

The timing of SMS reminders, rate (number sent) and type (generic or personalized) did not show any significant difference. All studies sent reminders within a fortnight of the appointment, with the majority of messages sent 48 h before the appointment time. Most studies reported the reason for sending the reminder within 48 h prior to the appointment time was to reduce the odds of a patient forgetting their appointment. This was previously identified as a leading reasons for appointment non-attendance [5–7]. This will also allow patients to cancel an appointment no longer required, or reschedule an appointment that now clashes with another commitment, which was also identified as a frequent reason for non-attendance. The reason provided for sending the reminder more than 48 h before the scheduled appointment was to allow for time to reallocate an appointment if it was to be cancelled, thus reduce waiting list and increasing the efficiency of the health service [33]. The analysis could not identify a linear relationship between the timing of the reminder and the appointment time. None of the studies examined the relationship between when the appointment time was set and when the appointment was held and the impact a SMS reminder had on the attendance rate. For example, where a patient is provided with an appointment in 3 months' time, compared to a patient provided with an appointment in 2 days' time, is there a difference in the attendance rate when provided with a SMS reminder, and is the length of time between the reminder and the appointment a lineal relationship to the length of time between when the appointment was made and when it is held. Future research is required in their area to ensure SMS reminders are sent once at the optimal time.

Similarly, the type of message (generic or personal) did not show any significant difference. Caution should be used with regards to the information contained in the message as concerns of privacy and confidentiality have previously been reported [8]. All studies that reported examples of SMS messages did not include any information concerning the reason for attendance, such as the condition or procedure. Information included in the SMS messages was restricted to time, date, place, health service and/or healthcare professionals' name (which may have privacy implications), with personalized messages addressing the patient by name (again, a privacy issue).

Specific considerations

None of the studies examined the attitudinal beliefs from staff and patients in sending/receiving SMS reminders. For example, it was not reported if staff received feedback from patients about receiving a SMS reminder, such as if the reminder prompted them to attend or cancel a forgotten appointment. Similarly, patients were not asked if receiving a SMS reminder was a positive or negative experience, the appropriateness of the timing of the reminder, the contents of the message or the impact of receiving only one or multiple reminders. Further research is required in these areas, as well as the impact of SMS reminders to culturally and linguistically diverse (CALD) patients on

appointment attendance rates, particularly where a message can be sent in a selected language. Furthermore, it has been postulated that SMS reminders may lead to a decrease in patient self-efficacy in appointment attendance through the reliance on a SMS reminder [26]. further research is required in this area as this could potentially have adverse implications for services not employing SMS appointment reminders or where there has been a system failure [31].

Cost effectiveness

Two studies examined the cost effectiveness of SMS reminders, reporting that programming a system to send SMS reminders automatically was a minimal investment that can usually be integrate into existing systems, such as electronic health records and administrative databases [20, 31]. Running costs were reported as minimal, with cost increases limited to increases in the number of texts sent or increases in the service provider's charges, with savings on physical items, such as stationary supplies and postage of reminder letters, and staff resources, such as the time to telephone patients with a reminder or to reschedule an appointment following non-attendance follow-up [31]. As systems can be automated, there is no requirement for staff training or labor costs. Moreover, these studies reported an increased profit compared to a low investment cost.

Meta-analysis comparison

As the methods employed by Guy and colleagues [12] were used in the design of this study, it was deemed important to compare our results against this earlier study, particularly as our study includes 5 years of recent data. Both studies reported high heterogeneity (this study $I^2 = 95.21$ %; Guy $I^2 = 90$ %) when including all study designs, with both studies finding this was largely due to the number of observational studies included in the analysis. Guy reported a low ($I^2 = 0$ %) heterogeneity among the RCT, whilst this study was moderate ($I^2 = 60.83$ %).

The important difference in findings was the pooled RCT odds ratio: 1.615 (1.347–1.936) for this study, 1.48 (1.33–1.72) for Guy's study. This may be due to an increased uptake of mobile phone usage in consumers, increased adoption of SMS reminder technology by healthcare organizations, improved technologies, greater reliance or acceptability of SMS reminders or any of the above mentioned factors. The authors of this paper have taken-away that this improved OR is a good indicator of the potential e-health has to improve efficiencies in health care delivery.

A possible limitation of this study is the authors did not contacted any of the authors of the papers analyzed for missing data, resulting in two studies not being included in the meta-analysis.

Conclusion

SMS appointment reminders are an effective method in improving appointment attendance in a health care setting. Although the analysis did not reveal any variability with respect to SMS timing, rate or type, age group, clinic setting or specialty, it did identify an improved odds ratio when compared to previous meta-analysis of SMS reminder effectiveness in reducing non-attendance. Further research is required to determine the optimal delivery timing and rate in relation to the length of time since the appointment was made, clinic setting and specialty type. Attitudinal experiences of staff and patients should also be explored as should the use of SMS reminders in CALD populations.

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Compliance with Ethical Standards

Conflict of Interests The authors declare that they have no conflict of interests.

Ethics Ethical approval was not required for this research.

Funding There is no funding associated with this research.

Appendix

Table 4 Standardised data collection form (used in MS Excel)

Article #	1	2	3	4
Author				
Publication year				
Study year/s				
Study design				
Country				
Setting type				
Specialty				
Reported age statistics (years)				
Control group #				
Intervention group #				
Total number of appointments				
Time final SMS sent before appointment 1 = <24; 2 = 24–48; 3 = >48 h; 4 = Not reported				
Number of SMS reminders sent 1; 2; 3; >3; Not reported				
Message type 1 = generic; 2 = Person; 3 = Not reported				
Control group attendance #				
Control group attendance %				
Intervention group attendance #				
Intervention group attendance %				
Follow-up data				

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