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Effect of SMS reminders on Attendance Rates for Healthcare Appointments: A Systematic Review & Meta-Analysis

Bobby Tang

Royal Victoria Eye & Ear Hospital, Adelaide Road, Dublin 2

ABSTRACT

Purpose: Non-attendance for healthcare appointments can adversely affect patients' clinical outcomes as well as being costly to healthcare systems. The aim of this study is to assess the role of mobile health (mHealth) interventions in tackling this problem.

Methods: A systematic review was conducted on several databases including the Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, Embase and PubMed. Overall 12 articles were selected for the review. A random effects model was used to estimate an overall effect size.

Results: SMS reminders significantly decreased the rate of non-attendance compared to no reminders (Risk ratio [RR] 0.77; 95% Confidence Interval [CI] 0.71, 0.84) with moderate heterogeneity (I2=32%) between studies. A funnel plot indicated no evidence of reporting bias.

Conclusions: SMS reminders significantly improve healthcare attendance rates across a wide range of clinical and socioeconomic settings. Utilization of SMS reminders are a cheap and effective method of improving patient attendance rates.

***Corresponding author**

Dr. Bobby Tang, Royal Victoria Eye & Ear Hospital, Adelaide Road, Dublin 2, UK. E-mail: btang02@qub.ac.uk

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Introduction

Low attendance rates for healthcare appointments pose significant problems, both in developed and developing countries. In 2003, the World Health Organization (WHO) stated that interventions aiming to improve adherence may have a far greater impact on the health of the population than any improvement in specific medical treatments and that patients should be supported in order to improve compliance [1]. One setting where the importance of attendance has been well established is in cancer screening. For example, epidemiological studies on cervical cancer survival have estimated that screening prevents 66-74% of cervical cancer deaths [2-4]. Despite this, cervical cancer screening in the UK only covered 73.5% of the eligible population in 2015, a figure that has fallen steadily since 2005 and it has been estimated that if everyone attended screening regularly in England, an additional 13% of cervical cancer deaths would be prevented each year [4,5].

Adverse effects of poor attendance have been shown for other non-communicable diseases (NCDs). For example, patients with diabetes mellitus who miss a significant proportion of their appointments (>30% of scheduled appointments) have significantly poorer glycemic control (HbA1c 0.70 - 0.79% higher) than those who attend regularly (after adjusting for demographic factors, clinical status, and health care utilization) [6]. As well as this, non-attendance has economic implications, not only with higher treatment costs associated with delayed diagnoses but also due to lost productivity. In 2012-2013, the cost of missed appointments in the National Health Service (NHS) was estimated at around £225 million [7].

One potential solution to improving attendance rates is the use of SMS reminders. Globally, there are over 5 billion wireless subscribers and commercial wireless signals cover over 85% of the world's population, thus making mobile health interventions very promising due to their wide penetration and low cost [8]. A recent review on mHealth by Gurol-Urganci et al. in 2013 compiled evidence from seven studies to conclude that text messaging reminders increase attendance at healthcare appointments compared to no reminders (RR 1.14; 95% CI 1.03, 1.26). Text messaging reminders were also shown to have the same impact as phone call reminders while being a less expensive alternative (RR 0.99; 95% CI 0.95, 1.02) [9]. However, there was a substantial degree of study heterogeneity in the pooled effects model and the quality of evidence was deemed low to moderate. The authors recommended further high-quality trials in mHealth before conclusive policy decisions can be made.

This systematic review includes RCTs which compare the effect of SMS reminders to no reminders on patients' attendance to healthcare appointments. Our objective is to update the existing data in order to inform further research.

Methods

Criteria for considering studies for the current review.

Types of studies

Only randomised controlled trials were included for this review.

Potential studies could be published or unpublished in any language with no restrictions placed on publication date.

Types of Participants
We included all patients attending a healthcare appointment irrespective of their gender, age and ethnicity. No restrictions were placed on disease type or the appointment setting whether it was from primary care, secondary care or community services.

Types of Intervention
We included studies where SMS reminders were used in isolation. This meant that studies using SMS reminders as part of a larger multifactorial intervention (e.g. text messaging and a phone call reminder) were excluded. In addition, the initial intervention had to be sent to the patient directly and not to a relative or carer. We only included studies which compared the intervention against no reminders as this is often the standard of care in low and middle-income countries.

Types of outcome measures
The primary outcome was the proportion in each group who did not attend their next healthcare appointment, either scheduled or unscheduled.

Search methods for identification of studies
A systematic search was conducted on the following databases: Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, Embase and PubMed. In addition to the listed databases an ongoing trial register was screened (WHO Clinical Trial Search Portal) and a manual search of references from included studies was also conducted. The following search terms were used: SMS, MMS, text messaging, attendance, adherence, randomised or randomized.

Data collection and analysis
Study selection
Study selection was conducted by the researcher who performed the literature search and another independent researcher. Both retrieved full text articles for potential inclusion after reviewing titles and abstracts. Any disagreements on study inclusion was resolved by discussion between the researchers.

Data extraction and management
The following data was extracted from included studies: general information (title, authors, source, publication details), setting (geographical and type of healthcare setting), study methods (eligibility criteria for participants, time of interventions), outcomes (proportion attending next appointment, cost analysis, adverse events, timing for measurements).

Risk of bias in included studies
This was assessed by the primary researcher using the Cochrane Risk of Bias Tool for Randomised Controlled Trials, which grades each criterion as 'low', 'high' or 'unclear' risk and the overall quality was rated according to thresholds specified by the Agency for Healthcare Research and Quality (AHRQ) [10]:

- **Good quality:** low risk of bias for all domains.
- **Fair quality:** One high risk criterion or two unclear criteria, and the assessment that this was unlikely to have biased the outcome.
- **Poor quality:** One high risk criterion or two unclear criteria, and the assessment that this was likely to have biased the outcome
- **Poor quality:** Two or more criteria listed as high or unclear risk of bias

Although part of the Cochrane Risk of Bias tool, masking was removed as one of the assessment criteria due to the nature of notification interventions and our judgment that the outcome is unlikely to be influenced by the lack of masking in these studies.

Synthesis of results and study heterogeneity
Heterogeneity is the variation in study outcomes which cannot be explained by sampling error. This was examined by calculation of the I2 statistic. Cochrane Collaboration offers the following interpretation of I2: 0-30% may represent little or no heterogeneity, 30-60% represents moderate heterogeneity, 50-90% represents substantial heterogeneity and 75-100% represents considerable heterogeneity [10]. With low to moderate heterogeneity, a meta-analysis will be conducted using a fixed or random effects model as appropriate and with high heterogeneity, individual study characteristics will be assessed for potential reasons.

Summary measures
As our outcome is a binary variable, we used risk ratio for our effect measures. A random or fixed effects model will be used in our pooled analysis depending on the heterogeneity between studies. With moderate or high heterogeneity heterogeneity (I2>30%) we will use a random effects model to obtain a more conservative estimate of the confidence interval.

Subgroup analysis
Due to the high degree of between-study heterogeneity identified by Gurol-Urganci et al. (2013) [9], we plan to conduct subgroup analyses for the following subgroups: studies from upper-middle and lower-middle income countries, studies from secondary care facilities, studies where the intervention consisted of a single reminder sent within 72 hours of appointment and studies of multiple reminders.

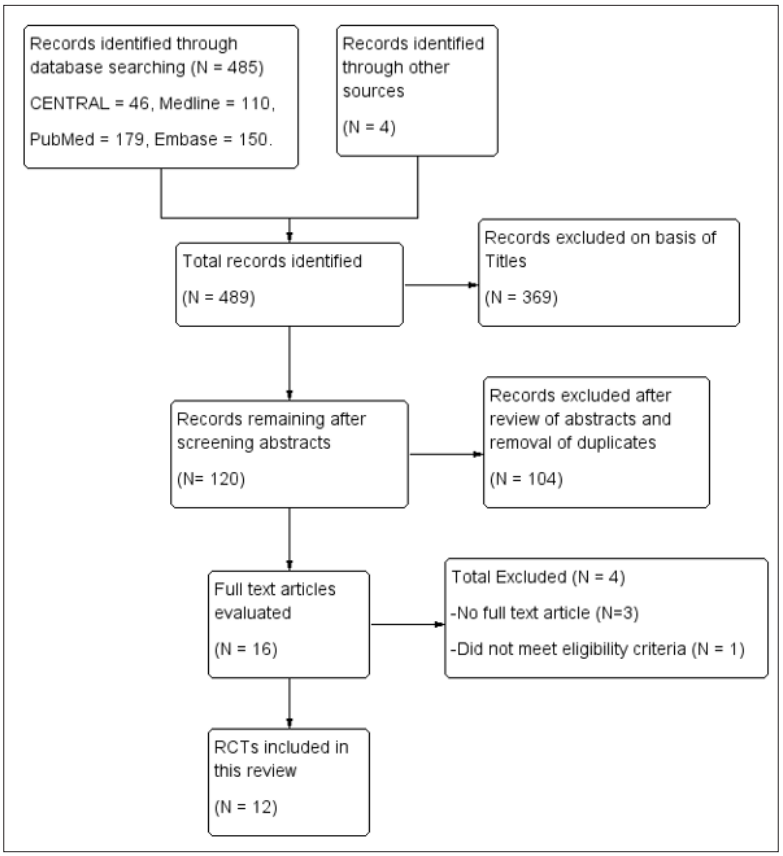
Assessment of reporting bias
We assessed reporting bias using funnel plots.

Statistical analysis
All statistical analysis and generation of tables and figures were conducted on Review Manager (RevMan) Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014.

Ethical considerations
No ethics approval was required as all included articles are published in the public domain.

Results
Included Studies
The search strategy identified 489 studies. After initial screening of the titles for basic relevance we retained 120 studies. This was reduced to 16 after review of abstracts to remove any studies that did not meet eligibility criteria and removal of duplicates. These were retained for full text review, although 3 of these were conference abstracts and full text articles had yet to be published and 1 was excluded as it did not meet eligibility. In total, 12 studies with 9,524 participants were selected for inclusion in this review (Figure 1) [11-23]. From the included studies we extracted information on the number and gender distribution of participants, the setting and type of appointment, disease type, timing of the intervention and whether the follow-up appointment was scheduled or unscheduled.

Figure 1: Flowchart of study selection



Our included studies were wide-ranging geographically with three from the UK two from Malaysia [18,19] and one each from the USA, China, Switzerland, Kenya, Nigeria, Australia and Saudi Arabia [12,17-19,22]. Five of the studies were from low-middle income countries. Seven of the studies were from hospital clinics or secondary care facilities, four were from primary care or general practice and one was from a health promotion center [11-22]. With the exception of Van Ryswyk et al. in which patients with gestational diabetes were sent text reminders to attend for a follow up appointment within 6 months, all other studies had scheduled appointments. (Appendix 1-2) [11].

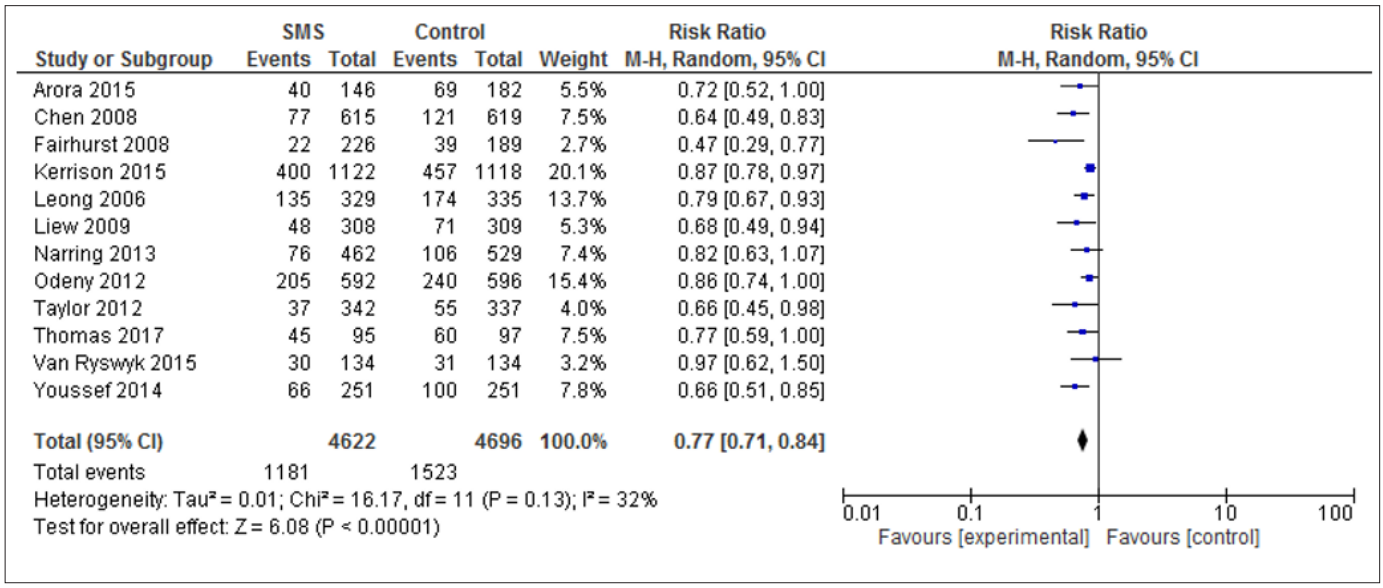
In eight studies, a single reminder was sent within 72 hours of the appointment [12,14-15,17-19,21-22]. One study sent reminders at 6 weeks, 3 months and 6 months post-partum [11]. Another sent reminders at 7, 3 and 1 day(s) before the follow-up at an emergency department [13]. Another sent daily informational messages to post-circumcision patients for 7 days with reminders to re-attend on the day before and day of the appointment and another sent reminders to patients attending a psychiatric clinic at 5 and 3 days before the appointment [16, 20].

The mean age of study participants ranged from under 20 to over 50. Most of the interventions were appointment reminders only, however, the study by Odeny et al. included daily messages on post-operative care and the study by Narring et al. included a text back option to cancel or reschedule the upcoming appointment [15,16]. The outcome of this study was the proportion of unexplained missed appointments without prior notification, although, the number of participants who cancelled their appointment was small (n=6, 0.61%) and therefore, this is unlikely to affect the overall results.

Effect of interventions

Figure 2 illustrates the results of our pooled analysis. Events are defined as non-attendance to the scheduled appointment or in the case of the study by Van Ryswyk et al. non-attendance within 6 months post-partum as recommended by the physician [11]. Overall, SMS reminders decreased the rate of non-attendance compared to no reminders (RR 0.77, 95% CI 0.71 to 0.84). There was moderate heterogeneity (I2=32%) between the studies and therefore a random effects model was used in the meta-analysis.

Figure 2: Forest plot with all 12 included studies



In the prespecified subgroup analyses, studies from upper-middle and lower middle-income countries (appendix 3) showed a significant reduction in non-attendance rates for the SMS group compared to no intervention (RR 0.78, 95% CI 0.70 to 0.86) with a low level of between study heterogeneity (I2 = 13%). Similarly, studies from secondary care facilities (appendix 4), showed a significant reduction in non-attendance rates for the SMS group (RR 0.79, 95% CI 0.72 to 0.87) with no study heterogeneity (I2 = 0%). Studies which involved a single SMS reminder sent within 72 hours of the appointment (appendix 5) had a greater reduction in non-attendance rates for the SMS group compared to no SMS (RR 0.73, 95% CI 0.65 to 0.83) and studies which used multiple reminders (appendix 6) had a similar effect although the reduction in the SMS group was not as great (RR 0.83, 95% CI 0.74 to 0.93).

Assessment of Bias in Included Studies

Using AHRQ thresholds, one study was rated as good quality, eight were deemed to be of fair quality and three were poor quality (Appendix 7) [11-22].

Assessment of Reporting Bias

The shape of the funnel plot in Figure 3 does not indicate any evidence of reporting bias; however, the relatively small number of studies and the paucity of low-powered studies makes it harder to interpret. The high-powered studies are over-represented in the top half of the graph, likely due to the ease in recruiting large numbers of participants to these trials.

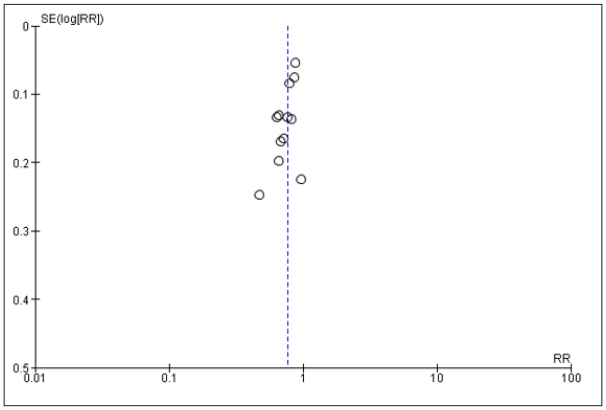


Figure 3: Funnel plot with all 12 included studies

Discussion

Summary of main results

This review includes 12 studies from a wide range of countries and various healthcare settings. It provides strong evidence that SMS interventions can be used to improve healthcare attendance rates where no reminders are the standard of care. Our pooled estimate had considerably less study heterogeneity (I2=32%) compared to previous reviews [9,23].

This may be due to our eligibility criteria which specified that studies had to be randomized controlled trials and that the SMS intervention was compared to no intervention. Furthermore, as we only included studies where the SMS reminder was sent to the patient directly, we excluded studies of pediatric populations from our analyses. Subgroup analyses show that text messaging interventions are also effective in middle income countries and in secondary care settings, although the use of multiple reminders has not been shown to be more effective in reducing non-attendance rates.

Strengths & Limitations

A strength of this study is the strict eligibility criteria which enabled the composition of a large homogenous data set. Overall, most studies were assessed to be of fair or good quality, although three had a high risk of bias. In the study by Leong et al. the outcome was defined as attending on the day of the appointment. In Malaysia the concept of 'walk-in' clinics is common and 48% of patients who attended on alternative days were classified as non-attenders although their overall healthcare outcomes were unlikely to be affected. In this case, classification bias might have caused the effect of the intervention to be underestimated [19].

Van Ryswyk et al. assessed the effect of SMS reminders on attendance to a post-partum diabetes clinic in women with gestational diabetes. This was limited by the high proportion of participants who also received postal reminders through a national reminder scheme (>83%). In addition, many of the patients' GPs were sent letters recommending further assessments (81%). Therefore, any difference in follow up between the intervention and control group is likely to have been minimized [11].

In the study by Fairhurst et al. the clustering effect of repeat appointments for the same patient was not accounted for. Overall,

415 appointments with 172 different patients were included in the study. This may have skewed the overall effect in our meta-analysis although this study had the smallest weighting of 2.7% and is unlikely to have had a large impact in the pooled analysis.

Conclusions

This systematic review provides evidence that SMS interventions improve attendance rates to healthcare appointments by 20-25%, both in high income countries and middle to low-income countries. The results may be used to inform further research, for example, in providing an estimate for sample size calculations and in highlighting a need for research on how to optimize text messaging reminders.

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Competing interests: The author has no relevant financial or non-financial interests to declare

Appendix

1. Overview of Study Characteristics

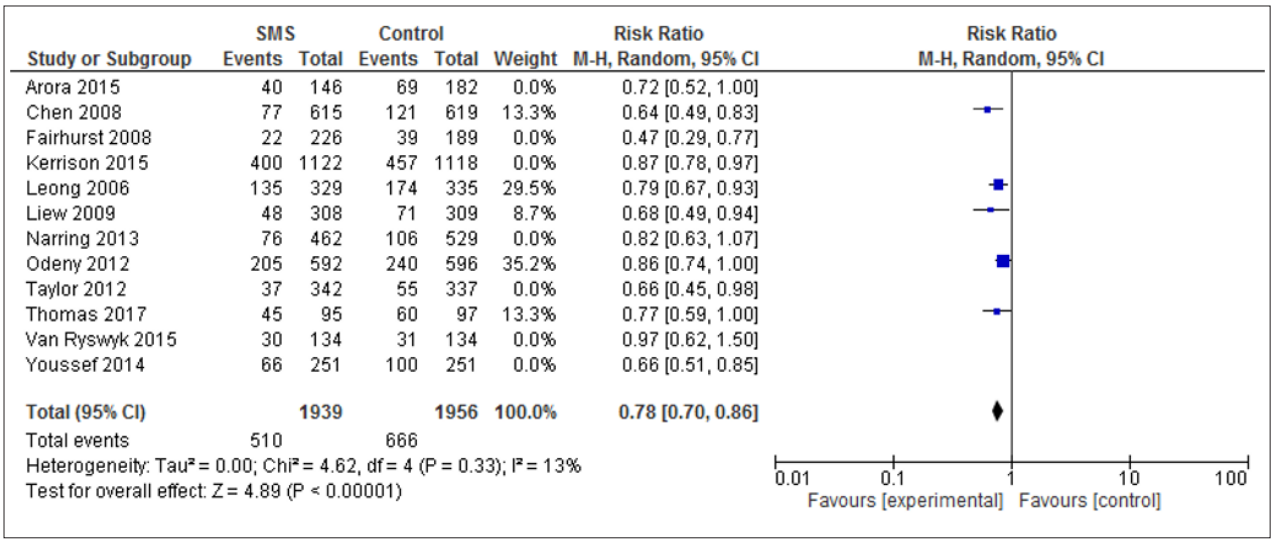
Included study	Country	Healthcare setting	Disease	Intervention timing	Appointment Type
Arora 2015	USA	Hospital/ secondary care	Various	7, 3 and 1 day beforehand	Scheduled appointment
Chen 2008	China	Health promotion centre	Various	72hrs prior to appointment	Scheduled appointment
Fairhurst 2008	UK	Primary care	Various	Morning of appointment or afternoon before	Scheduled appointment
Kerrison 2015	UK	Breast cancer screening	Various	7, 3 and 1 day beforehand	Scheduled appointment
Leong 2006	Malaysia	Primary care	Acute, chronic or preventative care	24-48 hours beforehand	Scheduled appointment
Liew 2009	Malaysia	Primary care	Chronic diseases	24-48 hours beforehand	Scheduled appointment
Narring 2013	Switzerland	Hospital / secondary care	Various	1 day beforehand	Scheduled appointment
Odeny 2012	Kenya	Hospital / secondary care	Post-circumcision	Daily post-op text messages for 7 days	Scheduled appointment (post op day 7)
Taylor 2012	UK	Hospital / secondary care	Physical therapy	1 or 2 days beforehand	Scheduled appointment
Thomas 2017	Nigeria	Hospital / secondary care	Psychosis	5 and 3 days beforehand	Scheduled appointment
Van Ryswyk 2015	Australia	Hospital / secondary care	Gestational diabetes	6 weeks / 3 months / 6 months post-partum	Unscheduled – within 6 months
Youssef 2014	Saudi Arabia	Hospital / secondary care	Various	48 hours beforehand	Scheduled appointment

2. Overview of patient characteristics

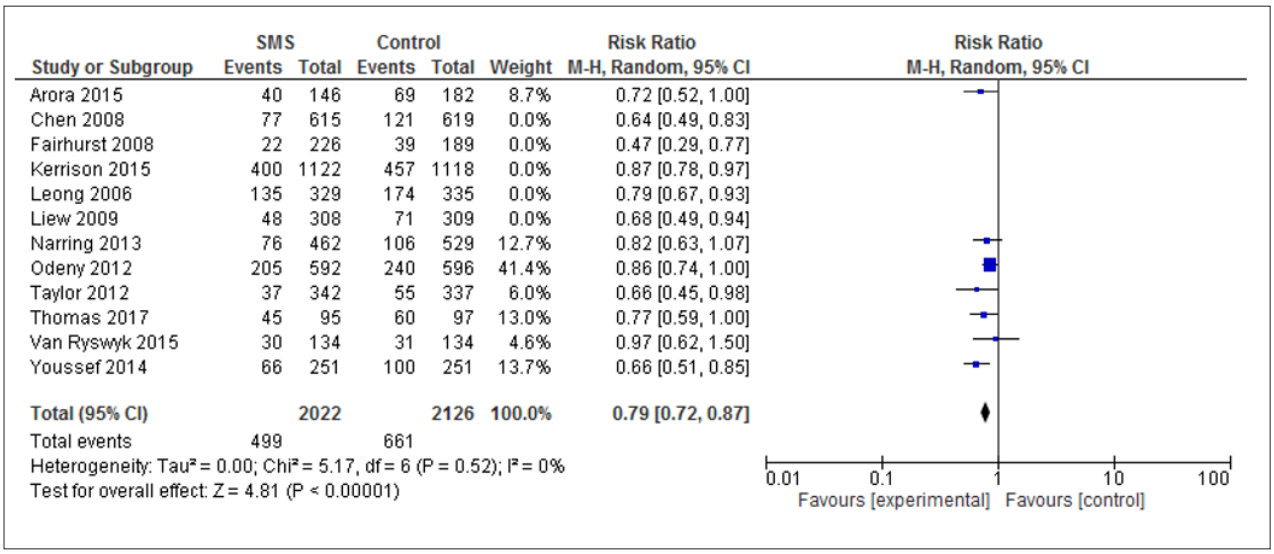
Study	No. of patients (M/F)	Mean age (SMS/control)	SMS group (DNA/total) (%)	Control group (DNA/total) (%)	Intervention characteristics
Arora 2015	156/172	44.9/46.1	40/146 (27.4)	69/182 (38.0)	Reminder only
Chen 2008	716/518	50.0/51.1	77/615 (12.5)	121/619 (19.5)	Reminder only
Fairhurst 2008	156/259	33.1/33.1	22/226 (9.7)	39/189 (20.6)	Reminder only
Kerrison 2015	0/2240	N/A	400/1122 (35.7)	457/1118 (40.9)	Reminder only
Leong 2006	229/435	38.4/37.8	135/329 (41.0)	174/335 (51.9)	Reminder only
Liew 2009	276/341	58.2/60.8	48/308 (15.6)	71/309 (23.0)	Reminder only
Narring 2013	241/750	17.7/17.7	76/462 (16.5)	106/529 (20.0)	Reminder + option to cancel/ reschedule
Odeny 2012	1188/0	N/A	205/592 (34.6)	240/596 (40.3)	Reminder + post-op instructions
Taylor 2012	263/416	37.5/36.9	37/342 (10.8)	55/337 (16.3)	Reminder only
Thomas 2017	88/104	33.5/33.9	45/95 (47.4)	60/97 (61.9)	Reminder only
Van Ryswyk 2015	0/168	32.1/32.8	30/134 (22.4)	31/134 (23.1)	Reminder only

Youssef 2014	213/289	52.0/53.0	66/251 (26.3)	100/251 (39.8)	Reminder only

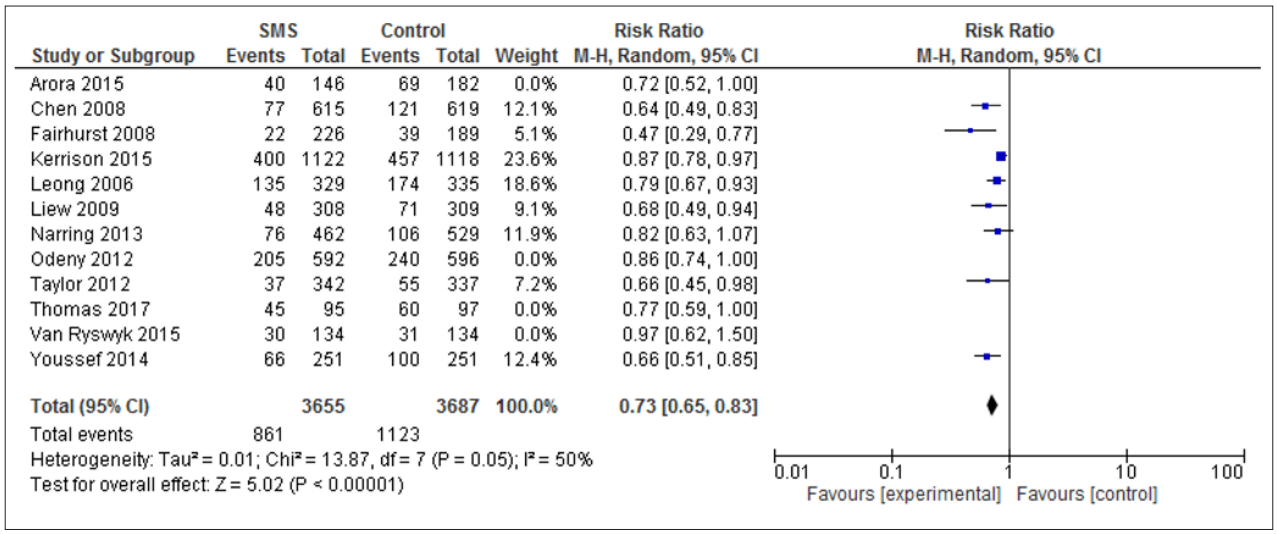
3. Forest plot of studies from upper-middle and lower-middle income countries



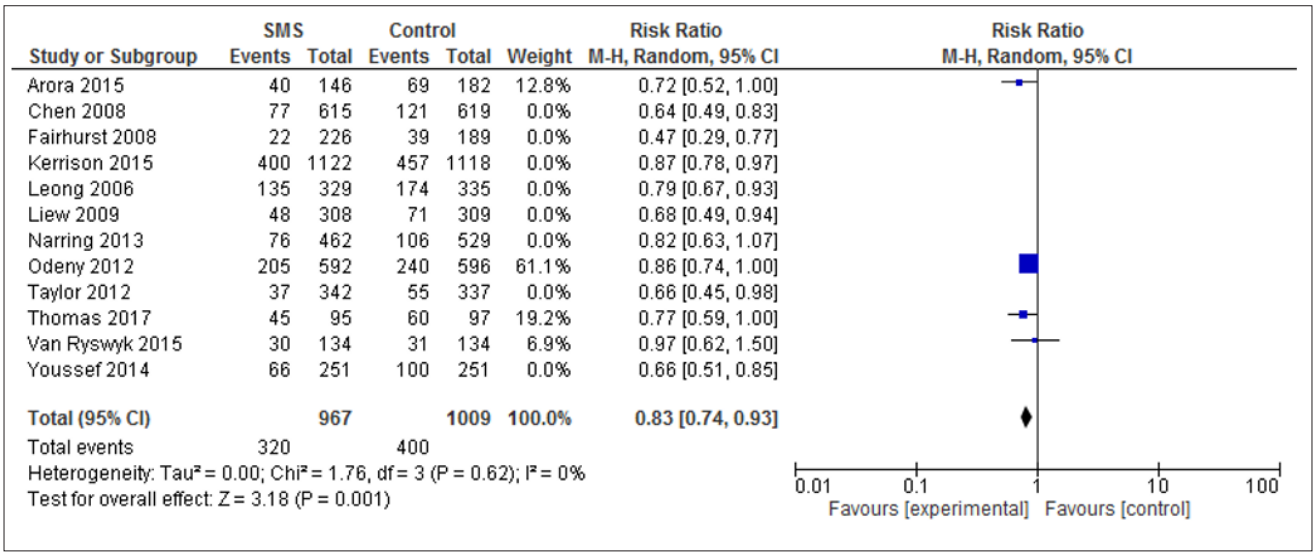
4. Forest plot with studies of hospital/secondary care settings



5. Forest plot with studies of single reminders sent within 72 hours of appointment



6. Forest plot of studies with multiple reminder interventions



7. Cochrane Risk of Bias Checklist

	Random Sequence Generation	Allocation concealment	Selective reporting	Other bias	Blinding of Outcome Assessment	Incomplete Outcome Data	Overall Quality
Arora 2015							Fair
Chen 2008							Poor
Fairhurst 2008							Fair
Kerrison 2015							Fair
Leong 2008							Poor
Liew 2009							Fair
Narring 2013							Fair
Odeny 2012							Fair
Taylor 2012							Good
Thomas 2017							Fair
Van Ryswyk 2015							Poor
Youssef 2014							Fair

Key:	
Low	
Unclear	
High	

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