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The effect of various types of patients' reminders on the uptake of pneumococcal vaccine in adults: A randomized controlled trial

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ABSTRACT

Background: Invasive pneumococcal disease is one of the most important vaccine-preventable diseases threatening the adult community due to missed opportunities for vaccination. This study compares the effect of three different types of patient reminder system on adulthood *Streptococcus pneumoniae* immunization in a primary care setting.

Methods: The study targeted patients aged 40 and older eligible for pneumococcal vaccine, but did not receive it yet (89.5% of 3072 patients) based on their electronic medical records in a family medicine center in Beirut. The sample population was randomized using an automated computer randomization system into six equal groups, receiving short phone calls, short text messaging system (sms-text) or e-mails each with or without patient education. Each group received three identical reminders spaced by a period of four weeks. Documentation of vaccine administration was then added to the longitudinal electronic patient record. The primary outcome was the vaccine administration rate in the clinics.

Results: Of the eligible patients due for the pneumococcal 23-polyvalent vaccine, 1380 who had mobile phone numbers and e-mails were randomized into six equal intervention groups. The various reminders increased vaccination rate to 14.9%: 16.5% of the short phone calls group, 7.2% of the sms-text group and 5.7% of the e-mail group took the vaccine. The vaccination rate was independent of the age, associated education message and the predisposing condition.

Conclusion: Use of electronic text reminders via e-mails and mobile phones seems to be a feasible and sustainable model to increase pneumococcal vaccination rates in a primary care center.

1. Introduction

Pneumococcal infection is a major cause of morbidity and mortality worldwide [1]. Invasive pneumococcal disease (IPD) is one of the most important vaccine-preventable diseases threatening the adult community due to missed opportunities for vaccination [1,2]. The rates (per 100,000 population) of IPD in adults older than 65 years in the United States (US) were estimated to be 30.2 in 2013 in contrast to 36.4 in 2010, 40.4 in 2008, 42.2 in 2003 and 60.5 in 1998, exceeding the Healthy People 2020 target of 31.0 per 100,000 [3]. However, more than half of deaths due to IPD occur in adults with specific risk factors (age ≥65 years, chronic diseases, immunosuppression) for severe disease [2,3]. Such risk factors are an indication for vaccination.

Although the 13-valent pneumococcal conjugate vaccine (PCV13) was recently added by the Centers for Disease Control and Prevention (CDC) to the adult immunization schedule in 2015 [4], the 23-Valent Pneumococcal Polysaccharide Vaccine (PPSV23) has been recommended since 1989 and is included in the CDC adult immunization schedules since first published in 2002–2003 [5]. PPSV23 contains 12 serotypes in common with PCV13 and 11 additional serotypes [2]. PPSV23 is cost effective and approximately 56–75% efficacious for the prevention of IPD caused by vaccine serotypes with long-lasting immunity [6–8]; however, it has been underutilized [9]. For example, among US adults aged ≥65 years, 38% and 20–25% of the IPD cases in 2013 were caused by serotypes unique to PPSV23 and by PCV13 serotypes, respectively, and are potentially preventable with the use of PPSV23 and PCV13 vaccines in this population [2]. Increasing pneumococcal resistance to antibiotics emphasizes the importance of vaccination [1,6]. Whereas the Healthy People 2010 goal in the US was to achieve at least 90% coverage for PPSV23 vaccine among persons aged ≥65 years and 60% for younger high-risk adults, CDC data for 2008 estimates that only 60% of non-institutionalized adults older

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than 65 years and 20% of younger high-risk adults received this vaccine [9].

In developed countries, the delay in implementation of adult immunization is mainly due to: lack of physicians knowledge, inadequate patients access to health services also known as physical barriers (waiting time, distance), vaccination cost, the focus on acute or chronic problems and the failure to follow and remind patients needing vaccination, along with patients' barriers such as lack of benefits' knowledge and safety concerns [10–13]. In Lebanon, concerning the pneumococcal vaccine, the most frequently reported barriers by physicians were patients' refusal, cost and physicians' concerns about efficacy followed by insufficient time and unknown immunization status [13].

Many interventions to increase pneumococcal vaccination were investigated in Western countries including assessment/audit which necessitates good recordkeeping, feedback to the health care providers (immunization coverage status compared with other practices and successful strategies used), providers' incentives (including financial), continuous quality improvement techniques, educational initiatives, organizational and/or team change, providers' reminders, patient-mediated interventions and reminder systems [10,14,15]. In reality, advanced communication technology, particularly mobile smart phones and internet based electronic mails (e-mails), represent an interesting tool to enhance physician–patient relationship and improve patients' awareness including patients' reminders/recalls [16]. In a 2005 Cochrane review (updated in 2009) including a meta-analysis of randomized trials, telephone reminder for pneumococcal vaccination was proven to be the most effective way compared to postcards and letters [17,18] with 2.3 times increase in patient demand for vaccination [18] and was thus advised to be implemented by organizations seeking to raise their vaccination rates despite its high cost [17,18]. In fact, recall and reminder by mail or telephone have been shown to work in several situations and are strongly recommended by the Task Force on Community Preventive Services. However, studies exploring the effect of mobile phone sms and e-mails in improving the rate of pneumococcal vaccination have not been published.

This intervention aimed at evaluating and comparing the effectiveness of two types of electronic reminder systems (mobile phone sms and e-mails) versus the gold standard short phone calls to improve PPSV23 vaccination rate in eligible adults in a family medicine center in Beirut, Lebanon. The electronic medical record (EMR) system in this center included computer-generated reminders that prompt primary care physicians of due health maintenance measures. Mobile phone voice message services were not available in Lebanon and thus were not included in the design.

2. Methods

This was a randomized controlled prospective study conducted between October 2014 and January 2015 targeting unvaccinated active patients (who had at least one visit to the clinic in the last 12 months) 40 years and older, who were either smokers, or who had a specific chronic disease (diabetes mellitus, chronic heart failure, asthma, chronic obstructive pulmonary disease, or coronary artery disease) and patients 65 years of age and older, who were beneficiaries of the American University of Beirut—Health Insurance Plan (AUB–HIP) program (89.5%, $n = 2750$ patients eligible for vaccination), and whose or their principle caretaker mobile phone numbers and e-mails were available in their EMR at the Family Medicine Clinics (FMC) at AUB. Exclusion criteria included lack of access to at least one of the reminder methods (mobile phone number or e-mail) or first degree relatives with the same mobile phone number or The sample population ($n = 1380$) was randomized using an automated randomization system into six equal subgroups each receiving a different type of reminder inviting them to get the PPSV23 vaccine. Subgroups 1a, 2a and 3a received, respectively, a standardized phone call reminder by a nurse, sms-text reminder and e-mail reminder; while subgroups 1b, 2b and 3b received, respectively, a standardized phone call reminder by a nurse, sms-text reminder and e-mail reminder, each with additional information about the seriousness of the pneumococcal disease representing the education intervention. Education consisted of a standardized script used identically in all three modalities: "Pneumococcal disease can cause pneumonia, bacteremia, meningitis and even death. Some people are more at risk than others: 65 years and older, smokers, and people who suffer from chronic diseases." Each subgroup received three identical reminders spaced by a period of four weeks.

In the reminder, patients were asked to call the clinic themselves and schedule an appointment to receive the vaccine. Presenting to a scheduled appointment and getting the vaccine was considered consent from the patient. The vaccine was paid out-of-pocket by the patients (16 US dollars). Data was retrieved and analyzed 4 weeks following the last reminder sent. The study was approved by the ethical review committee at the American University of Beirut. This work did not require any financial support.

2.1. Statistical methods

Based on previously published vaccine completion rates, for a statistically significant effect of $\geq$40% with a two-sided significance of 0.05 and a power of 80%, at least 98 patients per group were needed. To account for wrong phone numbers and e-mails, mislabeled disease coding at the clinic and other confounding causes altering the vaccination rate, groups of 230 patients each were selected randomly with a total of 1380 participants [19]. Data were entered to SPSS 19, and the vaccination rates of pneumococcal vaccine were calculated first at baseline, and then following the reminder interventions, with a comparison between the six distinct subgroups of the study. Frequencies and Chi-square tests were used to compare the outcomes of different interventions.

3. Results

The sample population ($n = 1380$) was randomly divided into six equal subgroups ($n1 = 230$, $n2 = 230$, $n3 = 230$, $n4 = 230$, $n5 = 230$ and $n6 = 230$) (Fig. 1). Around 9.8% (135 out of 1380) of the sample population received the vaccine at the FMC at AUB. The vaccination rate was statistically different comparing the short phone group to both e-mail and sms groups (16.5%, 7.2% and 5.7% of the groups short phone call, sms-text and e-mail, respectively) (Chi-square test, p-value <0.05) but not significant comparing sms to e-mail groups (Table 1). However, both sms and e-mail were significantly better than no intervention (1.1%, Chi-square test p-value <0.05, control group included patients excluded from the study having no e-mail or phone number or being a family member sharing the same contact information).

The actual rate of vaccination increased from 10.5% to 14.9% before and after this interventional survey, respectively: from 17.2% to 20.4% in patients older than 65 and from 4.0% to 9.7% in patients 40 to 65 years of age.

There was no statistical significance when dividing the data according to age and according to whether the reminder included patient education (Chi-square test, p-value >0.05) (Tables 1 and 2).

Further evaluation of the short phone calls revealed the data in Table 3. By limiting the analysis to those who actually received the intervention, a 26% vaccination rate was reached with short phone calls.

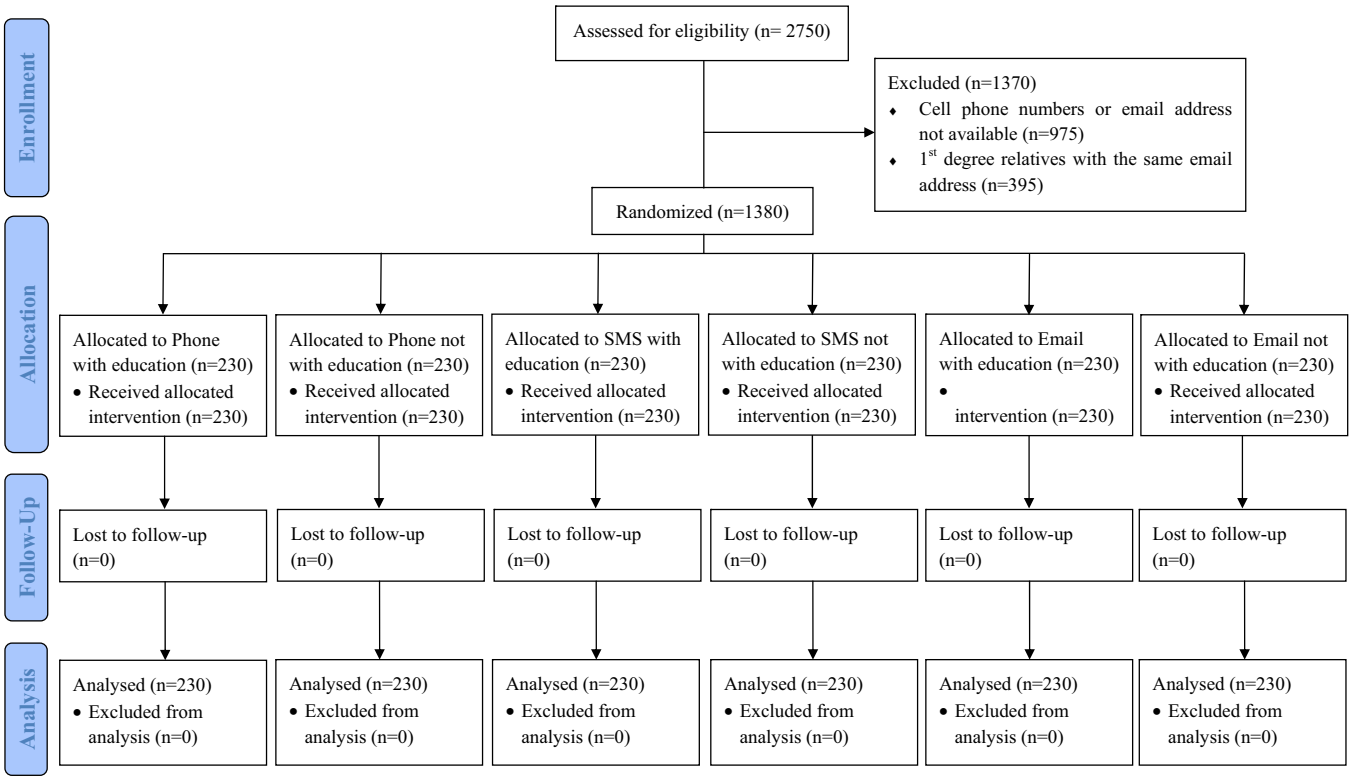

Fig. 1. The CONSORT flow diagram of the study done on adult patients eligible for PPSV23 vaccination benefiting from the Health Insurance Program at the American University of Beirut in 2014.

Table 1
Frequency and rate of vaccination (%) according to the six subgroups of intervention including patient education intervention.

	With education		Without education		Total	
	n[*]	(%)	*n*[*]	(%)	*n*	(%)
Phone	31	(13.5)	45	(19.6)	76	(16.5)
SMS	20	(8.7)	13	(5.7)	33	(7.2)
Email	12	(5.2)	14	(6.1)	26	(5.7)
Total	63	(9.1)	72	(10.4)	135	(9.8)

[*] *n* = 230 individual in each subgroup (phone, sms and e-mail).

Table 2
Frequency and rate of vaccination according to the three major groups of intervention according to age.

	Age 40–65		Age ≥65		Total	
	n	(%)	*n*	(%)	*n*	(%)
Phone	52	(17.1)	24	(15.4)	76	(16.5)
SMS	22	(7.2)	11	(7.1)	33	(7.2)
Email	13	(5.2)	13	(6.1)	26	(5.7)
Total	87	(9.5)	72	(15.4)	135	(9.8)

Table 3
Further evaluation of phone calls: reasons for not taking the vaccine.

	Phone with education		Phone without education	
	n	(%)	*n*	(%)
Vaccine already taken	5	(2.2)	7	(3)
Deceased	3	(1.3)	2	(0.9)
Home bound	3	(1.3)	3	(1.3)
Traveling	1	(0.4)	1	(0.4)
Physician refusal	9	(3.9)	4	(1.7)
Not answered/wrong number	74	(32.2)	28	(12.2)
Do not want the vaccine (against vaccine, allergy, misdiagnosis, cost)	12	(5.2)	15	(6.5)
Total	107	(46.5)	60	(26.1)

Furthermore, if we extrapolate the vaccination rate to the whole sample population, thus using the same intervention for the entire population, the rate would increase from a baseline of 10.5% to 25.3% with phone calls, 16.9% with sms-text and 15.5% with e-mails.

4. Discussion

This study revealed that all six patient-friendly technologies improved vaccination rate among the target group, and showed that short phone calls are superior to sms-text and e-mail without the need of patient education which had also a modest effect in a previous study [16]. Nevertheless, alongside the higher cost, phone calls required much more time allocation and staff dedication for execution in contrast to both sms-text and e-mail.

With the increasing implementation of EMRs, the capture of vaccination data is now easily feasible compared to the time-consuming individual chart review. Moreover, being prevalent, accessible and flexible, electronic technology provides promising modality to deal with vaccination communication barriers, especially with the growth of mobile phone use and texting along with the widespread use of internet and particularly e-mails in the Arab world [20]. However, sms use is currently more prevalent than internet [20]. For example, in Lebanon, mobile subscribers (3389,000) almost double internet subscribers (1730,914) and quadruple landline phone subscribers (912,132) [20]. However, in this study there was no significant difference between sms-text and e-mail reminders. This finding may be attributable to the fact that around 80% of mobile phone users in Lebanon are prepaid subscribers with high possibility of changing contact information frequently due to the short grace period provided by the mobile phone companies to recharge the phone line [20].

More than 41% of mobile smart phone users prefer sms health reminders over other modalities [21]. Mobile phone sms was found to be more attractive than other traditional modalities, better reaching the intended participant (as opposed to a letter or an automated phone reminder), and remaining on a person's mobile phone to be reviewed as needed [18]. In fact, 77% (46/60) of the sms studies showed improved outcomes [22]. Reviews revealed the effectiveness of sms-text reminders in improving healthcare appointments attendance [23], self-management of long-term illnesses such as diabetes mellitus [24,25], and adherence to smoking cessation and chronic medications [26–28]. In addition, sms was also shown to improve compliance with pediatric and adolescent immunization such as meningococcal (MCV4), tetanus–diphtheria–acellular pertussis (Tdap), Haemophilus influenzae B (Hib), influenza and human papilloma virus (HPV) (through reminders to parents) [16,29,30]. However, mobile sms-text reminders have a limited number of characters (160) in contrast to e-mail, although this issue can be overcome nowadays using the new mobile social media internet-based applications. Nonetheless, this may be actually helpful by forcing the message to be more concise and clear. Yet, the convenience of the timing of the reminder and the best exact number of reminders remain a challenge [31].

Concerning e-mail reminders, the literature is still limited. In a national study, some parents, especially those with higher household incomes and those who were older, were interested in e-mail vaccine reminders for their children [32]. The use of e-mail for the management of healthcare appointments and attendance reminders [33], and for health promotion and disease prevention [34] was found to lack any evidence of a significant effect. Nevertheless, both patients and providers acknowledged the improvement with communication through e-mail use despite concerns about confidentiality and security [35], and the lack of evidence base of the effect of e-mails in this area [36]. Yet, a nurse-led e-mail reminder program was found to be effective in a randomized controlled trial for cardiovascular prevention risk reduction in hypertensive patients [37]. E-mail reminder system had also a significant effect in increasing colorectal cancer screening [38].

Head to head and in a small pilot study, sms-text reminders were shown to be preferred over e-mail reminders to promote blood glucose monitoring in adolescents and young adults with diabetes [39]. To note that e-mail as sms is nowadays accessible through smart mobile phones and research demonstrated that people accessing the internet through smart phones rather than computers interact more with technology rather than simply consuming information which may increase the impact of interventions [16].

Of note several factors may have contributed to lower rates of completion and some of them were reported in the literature. The major issue was actually the fact that there was a shortage of PPSV23 vaccine in the stock during the first reminder which may negatively affect participation since patients had to call again later to reschedule an appointment [40]. In addition, the PPSV23 vaccines became available when the staff was preoccupied with the administration of the influenza vaccine to around 1200 individuals including medical and paramedical staff, therefore, reconsidering the timing of the reminder to a lighter season when the clinic is less crowded might be a solution. Since the PPSV23 vaccine is paid out-of-pocket, patients may have been reluctant to receive it or even would rather receive the vaccine elsewhere and save transportation costs. Reducing costs is one of proven strategies to increasing rates among specific populations [10]. Moreover, many employees (principle caretakers) received the reminders instead of the actual patients (spouse, parent. . .) which was confusing for some people (i.e. they did not understand that the target may be one of the family members).

5. Conclusion

Despite being safe and effective, the PPSV23 vaccine remains underutilized. Modern automated technology is an accepted, affordable and accessible modality to enhance vaccination rate and hence health outcomes. This randomized controlled trial revealed that automated text reminders are effective. Therefore, it is reasonable to first reach out to patients using both mobile phone sms and e-mails, which are more widely accessible, inexpensive and instantaneous to improve pneumococcal vaccination rate and its health outcome. Subsequently, phone calls may be harnessed to target the remaining unvaccinated population. In addition, it was shown that explaining the importance of the vaccine itself did not have a significant impact on vaccination. Also, the design of this study may have limited its success: inability to send personalized messages, provide participants with appointment. . . Future research should investigate whether a more adaptable and personalized system might be more successful.

Conflict of interest statement

The authors declare no conflict of interest.

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