Korean J Fam Med. 2010;31:284-293 doi:10.4082/kjfm.2010.31.4.284

Original Article

A Randomized Controlled Trial of SMS Text Messaging versus Postal Reminder to Improve Attendance after Lipid Lowering Therapy in Primary Care

Sung Ja Cho, Young Sik Kim*, Ho Cheol Shin[1], Eun Ju Sung[1], Dae Hyun Kim[2], Sangyeoup Lee[3], Tae Hee Jeon[4], Yun Jun Yang[5], Chung Hwan Cho[6], Hee-Cheol Kang[7], Yoo Seock Cheong[8]

Department of Family Medicine, University of Ulsan College of Medicine, Seoul, [1]Sungkyunkwan University School of Medicine, Seoul, [2]Keimyung University College of Medicine, Daegu, [3]Pusan National University School of Medicine, Busan, [4]Seoul Veterans Hospital, Seoul, [5]Inje University College of Medicine, Goyang, [6]Jeunju Jesus Hospital, Jeonju, [7]Yonsei University College of Medicine, Seoul, [8]Dankook University College of Medicine, Cheonan, Korea

Background: In the primary care setting, compliance with lipid lowering therapy was relatively low. In order to compare the efficacy of a short messaging service (SMS) text messaging and postal reminder as means of improving attendance rates during the first 24 weeks of lipid-lowering therapy, a randomized controlled trial of 918 patients from 19 family practice clinics was conducted between February 2003 and June 2006.

Methods: Patients were randomly assigned into 3 groups: SMS (327), postal (294),and control (297) group. To ascertain attendance rates, patients were followed up at 24 weeks after their treatment. Reminders were sent at 16 weeks from the coordinating center.

Results: Overall attendance rate was 74.1%. This differed between groups, with 76.1% attendance for the SMS group, 73.5% for the postal group, and 72.4% for the control group. According to a multivariate analysis, the SMS group had a significantly higher attendance rate (Odds ratios [OR] 1.48; 95% confidence interval [CI], 1.01 to 2.16) than the control group, but the postal group (OR, 1.15; 95% CI, 0.79 to 1.69) did not. Moreover, the cost per attendance for the SMS reminder (155 Korean Won [KRW]) was much lower than that for the postal reminder (722 KRW).

Conclusion: SMS reminder may be more cost saving method to improve the attendance rate compared with the postal reminder.

Keywords: Reminder; Text Messaging; Attendance; Randomized Controlled Trial

INTRODUCTION

Hyperlipidemia is one important risk factor for coronary artery disease, and one third of cardiovascular diseases result from hyperlipidemia.[1)] It has been widely reported that a treatment inducing lipid reduction in hyperlipidemic patients is effective in reducing the morbidity and mortality of cardiovascular disease.[2)] However, because hyperlipidemia has no apparent symptoms,

Received: May 8, 2009, Accepted: March 22, 2010

*Corresponding Author: Young Sik Kim
Tel: 02-3010-3811, Fax: 02-483-3290
E-mail: youngkim@amc.seoul.kr

This study was supported by a grant from Pfizer Korea.

Korean Journal of Family Medicine

patients are often unaware of the necessity of continuous treatment. This commonly leads to poor treatment adherence during long-term therapy.[3] The incidence of patients discontinuing treatment within one year after the onset of hyperlipidemia is reported to be approximately 15% to 60%.[4,5] A study carried out in Korea in 1999 also suggested a poor attendance rate to long-term therapy in Korean hyperlipidemic patients: the incidence of patients receiving continuous treatment for 6 months was only 52.3%,[6] which was consistent with the results of other comparative international studies.[5]

Various methods for improving treatment adherence have been tried, including improving patient knowledge of the disease and treatment, modifying patient behavior, and consolidating social support.[7,8] Telephone calls or postal reminders have commonly been used to change patient behavior with regard to keeping their next appointment[9] in circumstances where a disease confirmation is important (e.g., tuberculosis),[10] when completion of a vaccine schedule is critical (e.g., hepatitis),[11] where regular check-ups are necessary (e.g., producing mammograms),[12] or where patient enrollment is difficult (e.g., clinical trials).[13]

As computer and mobile phone technology develops, it has been suggested that e-mail or short messaging service (SMS) text messaging could also be used to deliver reminders.[14,15] Using SMS text messaging has been previously tested in several studies and compared to other methods (telephone calls, postal reminders or controls) but results appear to vary depending on the therapeutic study area.[16]

In Korea, University and medium-sized hospitals are increasingly using SMS text messaging to instruct patients on their medication administration methods and inform them about their visit schedules.[17] Sending large volumes of messages via the internet is becoming possible, and it is expected that SMS text messaging will be an important method for sending reminders to patients. However, few studies have been conducted in Korea with regard to intervention strategies to improve patient adherence to a chronic disease treatment, and no studies have evaluated the effectiveness of SMS text messaging as a reminder method. In addition, because all intervention strategies to improve patient adherence require time and expenditure of health care resources, whether such intervention strategies are cost-effective should be evaluated.[18,19]

Therefore, a randomized controlled trial was conducted to compare the effectiveness of SMS reminder and postal reminder on attendance rate and to analyze the cost-effectiveness of each reminder method in primary medical care facilities.

METHODS

1. Patient Population

The study was conducted in 19 hospital-based family practice outpatient departments from February 2003 until June 2006. Of 963 patients who were prescribed with atorvastatin, 45 patients who did not complete a questionnaire were excluded, leaving 918 patients in the study who agreed to receive postal or SMS reminders. The inclusion criteria of study subjects were: adult hyperlipidemic patients, aged 20 or above, and who required medication treatment. Patients who had previously taken atorvastatin were not eligible. Study medications were prescribed according to the instructions listed in the medication product insert. The dosage for each patient was determined by health practitioners and based on usual medical practice.

2. Study Design

We used a multi-center, randomized, single-blinded, controlled trial of the two reminder methods. A control group consisted of patients that did not receive either postal or SMS reminders. In order to maintain consistency in this multi-center study setting, a study coordinating center was responsible for randomizing reminders and sending standardized postal or SMS reminders. Patients were followed for 24 weeks after the administration of the study medication (Figure 1). This study was approved by the Institutional Review Board of the Asan Medical Center, where the coordinating office is located. Also, we received informed consents from study subjects.

3. Randomizing and Sending Reminders

The study coordinating center randomly assigned 918 registered patients into three groups: a postal reminder group, a SMS group or a control group. In the assignment procedure, 657 patients who owned mobile phones were randomized into the SMS, postal reminder or control group in a ratio of 2 : 1 : 1, respectively. The remaining 261 patients who did not have mobile phones were randomized into either the postal reminder or the control group in a ratio of 1 : 1. The sample sizes were thus 327, 294 and 297 for the SMS, postal and

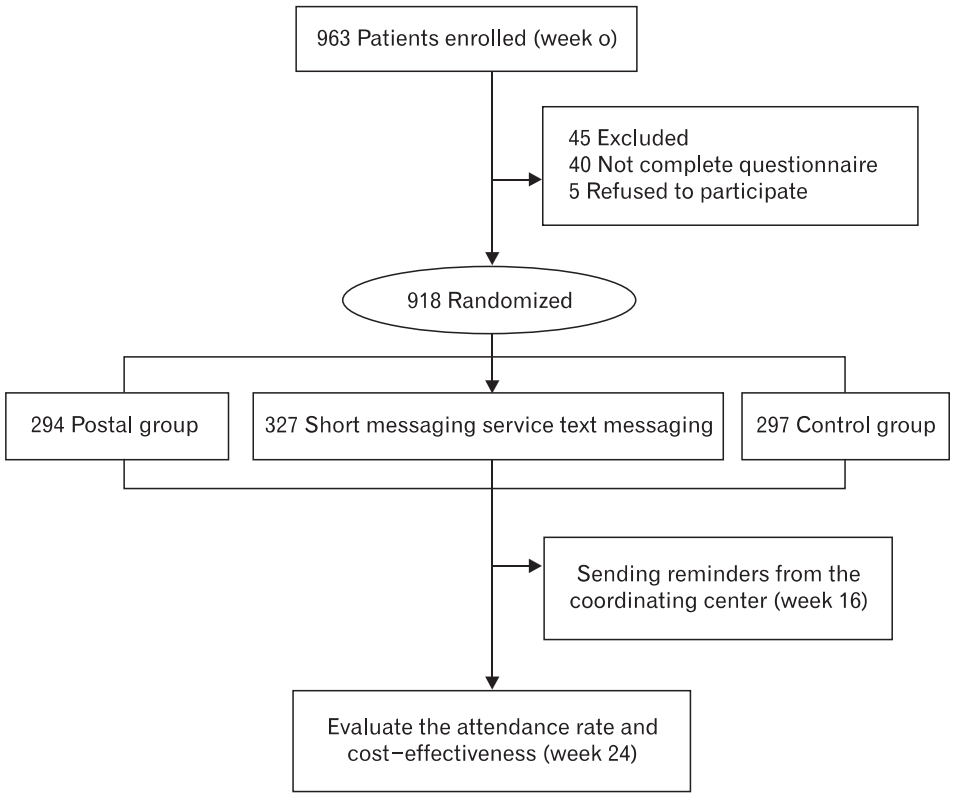

Figure 1. Flow of patients through the trial.

control groups respectively. The randomization sheet was generated by the SAS ver. 9.1 (SAS Inc., Cary, NC, USA). Group assignment was unknown to investigators until the completion of the study.

Postal and SMS reminders were generally sent from the coordinating center at 16 weeks after a patient's enrollment. Both SMS and postal reminders contained the following message: "Dear Mr./Ms… Have you taken the prescribed lipid lowering medication as scheduled? I hope to see you at your next visit on 0000 year 00 month 00 day, at 000 hospital, from doctor 000." SMS was sent using an internet program (MSN SMS, http://sms.msn.co.kr/sms/sms/group.asp).

4. Data Collection and Follow-up Visit

General patient data including age, gender, fat content in diet, exercise regime and smoking and drinking levels were collected at the first visit using a standardized self-reported questionnaire. Patients who were registered in the study coordinating center by investigators were followed up at 24 weeks after the administration of the study drug. Using a standardized questionnaire, information about a patient's medication adherence and any adverse events in response to prescribed drugs were collected at each visit. Height, weight and laboratory test results were recorded on a Case Report Form by investigators. All study subjects were advised to maintain a standard low fat diet during the study, and received the same relevant education materials.

5. Measurement of Attendance Rate

Patients who had visited out-patient clinics by week 24 were defined as the 'attender group' and patients who did not visit their clinic by week 24 were defined as the 'non-attender group'. The patients who called in by phone without visiting the clinic were considered non-attenders. Attendance rates were calculated for each reminder method based on the percentage of patients who visited at 24 weeks and patients enrolled in the baseline visit. Attendance rate of each reminder group was compared to that of the control group.

As indicators of patient adherence, clinical attendance was assumed to be valid measures because 1) the measurements are objective and easily applicable to primary medical condition, 2) other studies have successfully used the same methods,[9,20,21] and 3) we aimed to draw comparisons with a previous study conducted in hyperlipidemic patients 5 years ago in a similar clinical setting.[6]

6. Comparison of Unit Cost According to Reminder Method

To compare unit cost of each reminder method, the direct and indirect costs of sending reminders were calculated. Direct cost can be defined as any cost spent in producing the final product or service, and indirect cost can be defined as any cost spent during the course of production. It is more difficult to calculate indirect cost. For this study, only the direct cost of sending reminders was analyzed. This included expenses for materials and labor. Materials required to send postal messages included envelopes, printing paper, and stamps. Expenses incurred in purchasing those materials were included in the analysis. For the SMS group, it was determined that one text messaging reminder would be sent to each patient. The letter space in a single SMS allows up to 80 letters maximum, which comes out to exactly 40 Korean letters. The number of letters used in one reminder message was approximately 56 in Korean letters. Thus, the cost of sending one SMS reminder by a mobile phone to each patient was doubled to 5.84 cents. Labor cost for SMS was calculated as follows: total hours spent to send reminders divided by the total number of reminders multiplied by hourly researcher payments. Total hours spent sending reminders were recorded in a 'Sending Record' by a researcher of the study coordinating center. Payments to temporary researchers were set as 10,000 Korean Won (KRW) per hour for 160 hours per month. Indirect overhead costs (e.g., cost for administration, building and equipment) were not included in the analysis because it was difficult to assign such costs into each reminder group and was deemed unimportant in the analysis.[21)]

Cost-effectiveness of each reminder was calculated by comparing unit cost per patient attendance of each reminder, which was calculated.

7. Statistical Analyses

To enable detection of a difference of 10% in mean percent change in attendance rate between reminder and control groups with 80% power at a 5% significance level, it was estimated that 750 patients would need to be randomized using a ratio of 1 : 1 : 1 on the basis of a pilot study. Allowing for a 15% loss of follow-up, it was planned to randomize 900 patients.

Questionnaires completed by patients and case report forms completed by investigators were collected and sent to the study coordinating center for analysis using SAS 9.1. Comparisons of baseline characteristics among study groups and comparisons of patient characteristics between the 'Follow-up' and 'Drop-out' groups at their week 24 visit were performed using chi-square tests with a significance level set at 5%. The attendance rate of each reminder group was compared to the control group, and markers associated with attendance rate were analyzed, using chi-square tests and logistic regression with a 95% confidence interval (CI).

RESULTS

1. General Characteristics of Study Subjects

The general characteristics of 918 patients who completed self-reported questionnaires at the first visit and agreed to receive postal or SMS reminders were analyzed (Figure 1). There were more female patients (528, 57.5%) than male patients. Patients aged less than 50 years old, 50−60 years, and over 60 years represented 27.2%, 36.7%, 36.1% of the sample respectively. According to the criteria (BMI ≥ 25 kg/m^2) set by WHO Asia Pacific Region, 374 (46.4%) patients were obese. For behavior patterns, 43.4% of patients were on cholesterol lowering diets and 55.0% of patients were exercising once or more a week. In addition, 64.6% of patients were non-smokers, and 58.6% of patients were non-drinkers. The percentage of patients with an education level of more than 12 years was 32.0%, and 48.2%, of patients had a monthly family income of 1,500,000−5,000,000 KRW. Of the sample, 87.1% were married. Comparisons of general characteristics among study groups were made using chi-square tests, and only three significant differences were found. In the SMS text messaging group, 49.5% of patients were male, 32.1% of patients were less than the age of 50 and 47.7% of patients were drinkers, and these variables were significantly higher than the control and postal reminder groups (all P-values < 0.05) (Table 1).

2. Attendance Rate at the Week 24 Visit

All 918 hyperlipidemic patients were followed-up after 24 weeks. Of these, 238 patients stopped visiting their clinics and discontinued their treatments before 24 weeks. The remaining 680 patients continued to visit their clinics for treatment, giving an overall attendance rate of 74.1% (Table 2). Patients were subsequently divided into the attenders and non-attenders, and the demographic characteristics of the two groups were compared using chi-square tests. There were few significant differences between the two groups. Patients who were on low-fat diets, who had a history of

Table 1. Baseline characteristics of 918 subjects in each reminder group.

Reminders	Letter (N = 294)	SMS text messaging (N = 327)	Control (N = 297)
	no. (%)		
Gender†			
Male	110 (37.4)	162 (49.5)	118 (39.7)
Female	184 (62.6)	165 (50.5)	179 (60.3)
Age (y)‡			
< 50	71 (24.1)	105 (32.1)	74 (24.9)
50−59	97 (33.0)	138 (42.2)	102 (34.3)
≥ 60	126 (42.9)	84 (25.7)	121 (40.8)
Body mass index (kg/m^2)			
< 22	31 (12.0)	36 (12.3)	35 (13.7)
22−24.9	112 (43.2)	116 (39.7)	103 (40.2)
≥ 25	116 (44.8)	140 (48.0)	118 (46.1)
Low fat diet			
Yes	126 (42.9)	141 (43.1)	131 (44.1)
No	168 (57.1)	186 (56.9)	166 (55.9)
Exercise (frequency/wk)			
0	122 (44.8)	141 (44.9)	124 (45.3)
1−2	75 (27.6)	71 (22.6)	62 (22.6)
≥ 3	75 (27.6)	102 (32.5)	88 (32.1)
Smoking			
Current smoker	39 (13.4)	74 (22.8)	55 (18.6)
Ex-smoker	54 (18.6)	52 (16.1)	48 (16.3)
Non-smoker	198 (68.0)	198 (61.1)	192 (65.1)
Alcohol*			
Drinker	103 (38.0)	146 (47.7)	102 (37.6)
Non-drinker	168 (62.0)	160 (52.3)	169 (62.4)
Education (y)			
< 12	99 (39.0)	96 (32.9)	99 (38.8)
12	75 (29.5)	90 (30.8)	84 (33.0)
> 12	80 (31.5)	106 (36.3)	72 (28.2)
Income (KRW/mo)			
< 1,500,000	84 (36.4)	74 (26.7)	78 (32.6)
1,500,000−5,000,000	104 (45.0)	139 (50.2)	117 (49.0)
> 5,000,000	43 (18.6)	64 (23.1)	44 (18.4)
Marital status			
Married	234 (86.3)	264 (87.1)	239 (87.9)
Single, widowed or divorced	37 (13.7)	39 (12.9)	33 (12.1)
History of lipid lowering therapy			
Yes	42 (14.3)	47 (14.4)	33 (11.1)
No	252 (85.7)	280 (85.6)	264 (88.9)
Concomitant medication			
Yes	183 (62.2)	189 (57.8)	183 (61.6)
No	111 (37.8)	138 (42.2)	114 (38.4)

Missing values are excluded.
*P < 0.05, †P < 0.01, ‡P < 0.001 for chi-square test.

lipid lowering therapy, and who took concomitant medication had significantly higher attendance rates (79.9%, 91.0%, and 81.3%, respectively) than patients who were not on low fat diets, who had no history of lipid lowering therapy, and who did not take concomitant medication (69.6%, 71.5%, and 63.1%, respectively) (all P-values < 0.001) (Table 2).

3. Attendance Rate at Week 24 for Each Reminder Method

Attendance rate at week 24 was analyzed for each reminder method group. Both the SMS text messaging and the postal reminder groups had higher attendance rates than the control (76.1%, 73.5%, and 72.4%, respectively), but the differences were not significant (P > 0.05). Similarly, the odds ratio (comparison to control) was not significantly higher than 1 in either group (SMS text messaging group OR, 1.32; 95% CI, 0.93 to 1.86; postal reminder group OR, 1.14; 95% CI, 0.81 to 1.62).

A multivariate analysis was carried out to adjust for the effects of having different proportions among groups within some baseline variables (e.g., gender, age, drinking) and between the follow-up and drop-out groups. The effects of each reminder method compared to the control group were presented as odds ratios with their 95% confidence intervals (Table 3). Three models were tested. Model I did not adjust for the six variables that differed among groups. Model II adjusted for differences in age, gender and history of drinking

Table 2. Comparison of subject characteristics between the attenders and non-attenders (N = 918).

Variables	Non-attenders (N = 238)	Attenders (N = 680)
	no. (%)	
Gender		
Male	106 (44.5)	284 (41.8)
Female	132 (55.5)	396 (58.2)
Age (y)		
< 50	72 (30.2)	178 (26.2)
50−59	82 (34.5)	255 (37.5)
≥ 60	84 (35.3)	247 (36.3)
Body mass index (kg/m^2)		
< 22	35 (15.3)	67 (11.6)
22−24.9	87 (38.2)	244 (42.1)
≥ 25	106 (46.5)	268 (46.3)
Low fat diet*		
Yes	80 (33.6)	318 (46.8)
No	158 (66.4)	362 (53.2)
Exercise (frequency/wk)		
0	102 (47.5)	285 (44.2)
1−2	42 (19.5)	166 (25.7)
≥ 3	71 (33.0)	194 (30.1)
Smoking		
Current smoker	48 (20.5)	120 (17.8)
Ex-smoker	45 (19.2)	109 (16.1)
Non-smoker	141 (60.3)	447 (66.1)
Alcohol		
Drinker	95 (44.0)	256 (40.5)
Non-drinker	121 (56.0)	376 (59.5)
History of lipid lowering therapy*		
Yes	11 (4.6)	111 (16.3)
No	227 (95.4)	569 (83.7)
Concomitant medication*		
Yes	104 (43.7)	451 (66.3)
No	134 (56.3)	229 (33.7)

Missing values are excluded.
*P < 0.001 for chi-square test.

Table 3. Odds ratios and 95% confidence intervals (CI) of reminder methods on the attendance rate.

Model	Odds ratio (95% CI)		
	Control (72.4%)	Letter (73.5%)	Short messageing service text messaging (76.1%)
I*	1.00	1.14 (0.81−1.62)	1.32 (0.93−1.86)
II†	1.00	1.15 (0.80−1.66)	1.48 (1.02−2.14)
III‡	1.00	1.15 (0.79−1.69)	1.48 (1.01−2.16)

From logistic regression model with 'control'; *Unadjusted, †Adjusted for age, gender, alcohol, ‡Adjusted for age, gender, alcohol, low fat diet, history of lipid lowering therapy and concomitant medication.

between groups, but not the other three variables (3 of 6 variables). Model III included the remaining three variables of low fat diet, history of lipid lowering therapy and the taking of concomitant medication (6 of 6 variables).

Models II and III generated significant adjusted odds ratios for the SMS group of 1.48 (95% CI, 1.02 to 2.14) and 1.48 (95% CI, 1.01 to 2.16), respectively (P < 0.05) (Table 3). However, in the same models, the postal group had non-significant adjusted odds ratios of 1.15 (95% CI, 0.80 to 1.66) and 1.15 (95% CI, 0.79 to 1.69), respectively.

4. Comparison of Unit Cost According to Reminder Method

Expenses incurred for sending postal and SMS reminders by the study coordinating center were calculated based on the cost for materials and labor. The cost for materials for sending a single postal message was 231 KRW: envelope 25 KRW, printing paper 16 KRW, and stamp 190 KRW. The cost required to send a patient the SMS (comprising 2 screens) was 60 KRW. The time spent to send each reminder was calculated from the record entered by a researcher from the coordinating center. In order to send one postal message, 1 minute and 48 seconds was spent, while 21 seconds was spent to send a SMS. The labor cost was calculated from the time spent multiplied by hourly payments to the researcher as determined in the protocol.

The total cost spent to send messages to the postal reminder group was 155,914 KRW for 294 patients. Total cost for sending reminders to the SMS text messaging group was 38,620 KRW for

Table 4. Comparison of unit cost according to reminder method.

	Letter	SMS text messaging
No. of attendance	216	249
No. of intervention	294	327
Total time spent for intervention (h)	8.8	1.9
Total human resources cost (KRW)	88,000	19,000
Total reminder cost (KRW)	67,914	19,620
Total cost (KRW)	155,914	38,620
Total cost per patient (KRW)*	530	118
Total cost per attendance (KRW)†	722	155
Ratio of total cost per attendance‡	1.00	0.21

SMS: short messaging service, KRW: Korean Won.
*Total cost per patient = Total cost of each reminder / number of intervention. †Total cost per attendance = Total cost of each reminder / number of attendance. ‡The ratio of total cost per attendance of SMS text messaging to that of letter.

327 patients. The unit cost of each reminder was calculated from the total cost divided by the number of messages sent. The total cost per patient was 530 KRW for postal reminder and 118 KRW for SMS reminder. Although the attendance rates were not different between the postal group and the SMS group, the cost-effectiveness analysis showed that the total cost per attendance for SMS group (155 KRW) was significantly lower than that for the postal group (722 KRW). The ratio of total cost per attendance of SMS text messaging to that of letter was 0.21 (Table 4).

DISCUSSION

This study was designed to evaluate the effect and cost-effectiveness of different reminder methods in improving attendance rate in a primary care setting. We tested two methods – postal reminders and SMS reminders – against a control. Significantly more SMS text messaging group patients refilled their prescriptions by their week 24 visit compared to control group patients, whereas postal messages did not significantly increase this measure. In addition, sending SMS reminders was 4.7 times more cost-effective than sending postal messages. These results suggest that SMS text messaging is more effective than traditional postal messages in terms of improving both attendance rate and cost-effectiveness. In Korea, the Internet and mobile phones are widely used. With the current rapidity and confidentiality of sending SMSs, we suggest that this method is suitable as a new cost-effective reminder method for widespread use in clinical practices.

To improve adherence to therapy regimes, many reminder methods have been previously tested. Traditionally, postal and telephone reminders have been most commonly used in studies. In this study, although a higher proportion of the postal reminder group refilled their prescriptions than the control group, the difference was not statistically significant. This is consistent with several other studies,[22] but differs from the result of one study that reported that sending mailed reminders reduced missed appointments by 34%.[20]

Overall attendance rate in this study was 74.1% (680/918) in the two reminder groups and 72.4% (215/297) in the control group, which were much higher than the attendance rate in our previous study (52.3% at 24 weeks after the treatment).[6] The relatively high attendance rate in the control group makes the reminder's beneficial effect less visible. The reason for the high attendance rate in the control group may be due to the fact that the present study obtained informed consents from all study participants regarding receiving a reminder through either a postal or a SMS text message prior to the initiation of the study, while the previous study which was conducted several years ago did not. This may have an effect on patient recognition and behavior, resulting in improved attendance. This is consistent with one report that demonstrated that patients who gave informed consent and who participated in a study tended to exhibit higher treatment adherence compared to those who did not participate in the study.[19] Our data also support this assumption because 122 (13.3% of 918) patients who had a history of lipid lowering therapy showed a higher attendance rate than patients without a therapy history.[6] We suggest that the improvement of disease knowledge and behavior may have resulted in the observed increase in overall attendance rate between the two studies.

Recently, various types of reminders (e.g., e-mail messaging)[23] have been investigated for their abilities to improve adherence to the administration of birth control pills, as well as for computerized knowledge management in diabetes care.[24] At a hospital in England, for example, the non-adherence rate to clinic attendance decreased by approximately 8% after the introduction of SMS text messaging.[15] SMS text messaging has been commonly used by the financial and circulation industries for customer relationship management. As it has become more broadly adopted as an innovative reminder

method, it is now used to inform patients of their appointment schedules or provide simple health care messages. SMS text messaging is rapid compared to mailed reminders, and is easily accessible compared to computer e-mail. Land-line telephones have been previously used in many adherence studies, although it has proved difficult to directly contact patients and was not cost-effective.[20] Also, mobile phone reminder was less cost-effective compare with SMS reminder in recent study.[25] Considering that people generally carry their mobile phones with them, SMSs that can be repeatedly sent may be more effective at reminding patients compared to land-line phone reminder, which typically consists of only a single message. In addition, SMS text messaging is more confidential, restricting messages to the intended recipient.[26]

According to this study, SMS text messaging significantly improved hospital attendance compared to the control group, which was consistent with another study.[14,15] We also showed that SMS text messaging is significantly more cost-effective than postal messaging. There is, however, a technical shortcoming in the use of SMSs, namely that a message must be relatively simple and cannot exceed 80 characters/spaces. In contrast, postal messages can include not only a simple reminder message for the next appointment, but also contain information pertaining to treatment administration methods and effective disease management. Combining the use of these two reminder methods may be the most effective way of improving patient adherence, and this should be investigated in a future study.

In the calculation of costs, indirect overhead costs including expenses spent in administration, building or equipment were not included because it was difficult to allocate these costs and they were deemed unimportant in the calculation of the cost of each reminder method. However, in receiving postal messages, no additional cost is incurred by the patient, whereas to receive SMSs patients must have a mobile phone. In this study, patient-related factors for non-attendance were being a new patient, not following a low fat diet and not taking concomitant medication. New users had significantly lower compliance than previous users, which was consistent with some,[6,27] but not all previous studies.[5] Lack of low fat diet was associated with non-attendance, suggesting that these patients adopted less healthy behaviors overall. This is consistent with other reports.[6,28] There was a significantly higher attendance among patients receiving a co-prescription for cardiovascular or anti-diabetic drugs compared with those without such co-medication, presumably because they were accustomed to long-term drug therapy. This is consistent with other studies.[5,6,27]

A problem with internal validity in this study may be present because some demographic variables had different proportions in different groups. In the SMS text messaging group, 41.0% of patients were male, 42.0% were aged less than 50 years of age, and 41.6% were drinkers. These variables were significantly higher than those of the control and postal reminder groups. This indicates that a higher number of younger male patients were assigned to the SMS text messaging group compared to the postal reminder or the control group. This discrepancy was due to the fact that there were more younger male patients among the mobile phone users. Thus, we analyzed the relationship between the reminders and clinic attendance using multivariate models with the above variable.

A second problem of external validity may also be present because our study subjects were restricted to patients from hospital-based family practice clinics. However, in the Korean medical environment, patients seen in hospital-based and community-based family practice settings cannot be differentiated.[29] Patients are able to seek care at family practice clinics of secondary and tertiary medical centers without referrals and their medical insurance reimbursement is not penalized for doing so. Objective evaluation of the characteristics of patients visiting hospital-based and community-based family practice clinics, such as the composition of complaint types, also showed no difference between these patient groups.[29] Thus, we believe our study subjects represent the general population in primary care in Korea, and we therefore consider that the behavior of hyperlipidemic patients in our study will be similar to other general primary care settings. Despite the above limitations, the present study provides valuable information on the potential of using SMS text messaging as a new reminder method.

In conclusion, the SMS text messaging group showed a significantly higher attendance rate at 24 weeks after lipid lowering therapy compared to the control group, and SMS reminder was more cost-effective than postal reminder.

요약

연구배경: 일차의료에서 지질저하제에 대한 순응도는 높지 않은 것으로 알려져 있다. 이에 지질저하제 치료 후 외래방문율을 개선시키기 위한 휴대폰 문자메시지와 편지 회상법간의 효과를 대조군과 비교하는 무작위배정 다기관 임상시험을

2003년 2월부터 2006년 6월까지 19개 병원 가정의학과에서 수행하였다.

방법: 918명의 고지혈증환자를 휴대폰 문자메시지군(327), 편지군(294) 및 대조군(297)으로 무작위 배정하였다. 외래방문율을 평가하기 위해 최초 투약 후 24주에 외래방문을 추적조사 하였으며, 회상법은 16주에 1회 연구조정센터에서 연구자 맹검으로 발송하였다.

결과: 전체 방문율은 74.1%이었으며, 문자메시지군은 76.1%, 편지군은73.5%, 대조군은 72.4%이었다. 다변량분석에 의하면 문자메시지군이 대조군보다 방문율(Odds ratios [OR] 1.48; 95% confendence interval [CI], 1.01−2.16)이 유의하게 높았으나 편지군은 대조군과 차이가 없었다(OR, 1.15; 95% CI, 0.79−1.69). 방문자 1인당 비용은 문자메시지군이 155원으로 편지군의 722원보다 4.7배 저렴하였다.

결론: 지질저하제 치료 후 외래방문율을 개선시키는데 있어서 휴대폰 문자메시지가 편지보다 비용절감 효과가 있었다.

중심단어: 회상법; 휴대폰 문자메시지; 방문율; 무작위배정 대조군 임상시험

REFERENCES

1. World Health Organization. The world health report 2002. Geneva: World Health Organization; 2003.
2. Frick MH, Elo O, Haapa K, Heinonen OP, Heinsalmi P, Helo P, et al. Helsinki Heart Study: primary-prevention trial with gemfibrozil in middle-aged men with dyslipidemia. Safety of treatment, changes in risk factors, and incidence of coronary heart disease. N Engl J Med 1987;317:1237-45.
3. Insull W. The problem of compliance to cholesterol altering therapy. J Intern Med 1997;241:317-25.
4. Andrade SE, Walker AM, Gottlieb LK, Hollenberg NK, Testa MA, Saperia GM, et al. Discontinuation of antihyperlipidemic drugs--do rates reported in clinical trials reflect rates in primary care settings? N Engl J Med 1995;332:1125-31.
5. Simons LA, Levis G, Simons J. Apparent discontinuation rates in patients prescribed lipid-lowering drugs. Med J Aust 1996;164:208-11.
6. Kim YS, Sunwoo S, Lee HR, Lee KM, Park YW, Shin HC, et al. Determinants of non-compliance with lipid-lowering therapy in hyperlipidemic patients. Pharmacoepidemiol Drug Saf 2002;11:593-600.
7. Seo HK. Strategies to improve patients' adherence. J Korean Acad Fam Med 1999;20:1542-8.
8. Roter DL, Hall JA, Merisca R, Nordstrom B, Cretin D, Svarstad B. Effectiveness of interventions to improve patient compliance: a meta-analysis. Med Care 1998;36:1138-61.
9. Nazarian LF, Mechaber J, Charney E, Coulter MP. Effect of a mailed appointment reminder on appointment keeping. Pediatrics 1974;53:349-52.
10. Tanke ED, Martinez CM, Leirer VO. Use of automated reminders for tuberculin skin test return. Am J Prev Med 1997;13:189-92.
11. Sansom S, Rudy E, Strine T, Douglas W. Hepatitis A and B vaccination in a sexually transmitted disease clinic for men who have sex with men. Sex Transm Dis 2003;30:685-8.
12. Saywell RM Jr, Champion VL, Skinner CS, McQuillen D, Martin D, Maraj M. Cost-effectiveness comparison of five interventions to increase mammography screening. Prev Med 1999;29:374-82.
13. Nystuen P, Hagen KB. Telephone reminders are effective in recruiting nonresponding patients to randomized controlled trials. J Clin Epidemiol 2004;57:773-6.
14. Chen ZW, Fang LZ, Chen LY, Dai HL. Comparison of an SMS text messaging and phone reminder to improve attendance at a health promotion center: a randomized controlled trial. J Zhejiang Univ Sci B 2008;9:34-8.
15. Dyer O. Patients will be reminded of appointments by text messages. BMJ 2003;326:1281.
16. Bos A, Hoogstraten J, Prahl-Andersen B. Failed appointments in an orthodontic clinic. Am J Orthod Dentofacial Orthop 2005;127:355-7.
17. Song YJ. Information of medical care by cellular phone and e-mail [Internet]. Hankuk Il-Bo. 2003 Sep 29 [cited 2010 Mar 29]. Available from: http://www.yoosincnc.com/biz_ctt.asp?num=9&p=4.
18. Bender B, Milgrom H, Apter A. Adherence intervention research: what have we learned and what do we do next? J Allergy Clin Immunol 2003;112:489-94.
19. Heidenreich PA. Patient adherence: the next frontier in quality improvement. Am J Med 2004;117:130-2.
20. Shepard DS, Moseley TA 3rd. Mailed versus telephoned appointment reminders to reduce broken appointments in a

hospital outpatient department. Med Care 1976;14:268-73.
21. Warner KE, Luce BR. Cost-benefit and cost-effectiveness analysis in health care. Ann Arbor (MI): Health Administration Press; 1982. p. 78.
22. Guthrie RM. The effects of postal and telephone reminders on compliance with pravastatin therapy in a national registry: results of the first myocardial infarction risk reduction program. Clin Ther 2001;23:970-80.
23. Fox MC, Creinin MD, Murthy AS, Harwood B, Reid LM. Feasibility study of the use of a daily electronic mail reminder to improve oral contraceptive compliance. Contraception 2003;68:365-71.
24. Balas EA, Krishna S, Kretschmer RA, Cheek TR, Lobach DF, Boren SA. Computerized knowledge management in diabetes care. Med Care 2004;42:610-21.
25. Leong KC, Chen WS, Leong KW, Mastura I, Mimi O, Sheikh MA, et al. The use of text messaging to improve attendance in primary care: a randomized controlled trial. Fam Pract 2006;23:699-705.
26. Newell A. A mobile phone text message and Trichomonas vaginalis. Sex Transm Infect 2001;77:225.
27. Avorn J, Monette J, Lacour A, Bohn RL, Monane M, Mogun H, et al. Persistence of use of lipid-lowering medications: a cross-national study. JAMA 1998;279:1458-62.
28. Kiortsis DN, Giral P, Bruckert E, Turpin G. Factors associated with low compliance with lipid-lowering drugs in hyperlipidemic patients. J Clin Pharm Ther 2000;25:445-51.
29. Suh YS, Ahn EJ, Kang HC, Bae CY, Shin DH. The analysis of clinical contents in primary care in university-based family practice clinics. J Korean Acad Fam Med 1992;13:327-34.