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Chen, T., Zhu, W., Tang, B., Jin, L., Fu, H., Chen, Y., Wang, C., Zhang, G., Wang, J., Ye, T., Xiao, D., Vignarajan, J., Xiao, B., Kanagasingam, Y., & Congdon, N. (2018). A Mobile Phone Informational Reminder to Improve Eyecare Adherence among Diabetic Patient in Rural China: A Randomized Controlled Trial. *American Journal of Ophthalmology*, 1-25. Advance online publication. https://doi.org/10.1016/j.ajo.2018.07.006

Published in:
American Journal of Ophthalmology

Document Version:
Peer reviewed version

Queen's University Belfast - Research Portal:
Link to publication record in Queen's University Belfast Research Portal

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Download date:29. Apr. 2024

Accepted Manuscript

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PII: S0002-9394(18)30387-8

DOI: 10.1016/j.ajo.2018.07.006

Reference: AJOPHT 10575

To appear in: *American Journal of Ophthalmology*

Received Date: 22 April 2018

Revised Date: 10 July 2018

Accepted Date: 11 July 2018

Please cite this article as: Chen T, Zhu W, Tang B, Jin L, Fu H, Chen Y, Wang C, Zhang G, Wang J, Ye T, Xiao D, Vignarajan J, Xiao B, Kanagasingam Y, Congdon N, A Mobile Phone Informational Reminder to Improve Eyecare Adherence among Diabetic Patient in Rural China: A Randomized Controlled Trial, *American Journal of Ophthalmology* (2018), doi: 10.1016/j.ajo.2018.07.006.

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Abstract

Purpose: To determine whether short message service (SMS) reminders improve adherence to scheduled ocular examinations among patients with diabetes in rural China.

Design: Randomized controlled trial

Methods: This study enrolled consecutive patients with diabetes scheduled for eye examinations at 5 hospitals in low-income areas of Guangdong, China from 1 March 2015 to 31 May 2016. Participants were randomized (1:1) to receive automated SMS reminders containing information about diabetic retinopathy (DR) 1 week and 3 days prior to scheduled eye appointments (Intervention) or to appointments without reminders (Control). Regression models following intention-to-treat principles were used to estimate the association between the main outcome (attendance within ± 1 week of scheduled visit) and membership in the Intervention group, with and without adjustment for other potential predictors of follow up. Secondary outcomes included change in DR knowledge score (1 worst - 5 best) and endline satisfaction with care (3 worst - 15 best).

Results: Among 233 patients, 119 (51.1%) were randomized to Intervention (age 59.7±11.3 years, 52.1% men) and 114 (48.9%) to Control (58.7±9.50 years, 49.1% men). All participants provided data for the main study outcome. Attendance at scheduled appointments for the Intervention group (51/119, [42.9%]) was significantly higher than for Controls (16/114, [14.0%], between-group difference 28.8% [95% Confidence Interval [CI] 17.9%, 39.8%], P<0.001).Factors associated with attendance in multiple regression models included Intervention group membership (Relative Risk[RR] 3.04, 95% CI, 1.73-5.33, P<0.001) and baseline DR knowledge (RR 1.47, 95% CI 1.21-1.78, P<0.001). Improvement in Satisfaction (mean difference 1.08, 95% CI 0.70-1.46, P<0.001) and DR knowledge (mean difference 1.30, 95% CI 0.96-1.63, P<0.001) were significantly higher for the Intervention group. Total cost of the intervention was USD$5.40/person.

Conclusion: Low-cost SMS informational reminders significantly improved adherence to, knowledge about and satisfaction with care. Additional interventions are needed to further improve adherence.

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A Mobile Phone Informational Reminder to Improve Eyecare Adherence among Diabetic Patient in Rural China: A Randomized Controlled Trial

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Meeting Presentation: This work was presented at the Association for Research in Vision and Ophthalmology (ARVO) Annual Meeting, Baltimore, USA, May 2017

Short title: A Message Reminder to Improve Diabetes Eye care adherence

Key words: Diabetic retinopathy, short message reminder, adherence, eye care, rural, China, diabetes

Length: Text: 3006 words; Tables: 3; Figures: 1; Abstract: 297 words.

Trail Registration: The trial was registered at the US National Institutes of Health (ClinicalTrials.gov) website, #NCT01837121

Version: 21 June 2018

Introduction

Since 1980, the global age-standardized prevalence of diabetes has increased by some 20%,[1] corresponding to approximately 150 million additional people living with the disease.[2] A large proportion of this increase has been attributed to steep rises in China, where the estimated population prevalence of diabetes rose from 1% in 1980 to 11.6% in 2010.[3-5]

Between 1990 and 2010, blindness and visual impairment due to diabetic retinopathy (DR) underwent global increases of 27% and 64% respectively, almost entirely due to rising prevalence in low and middle-income countries.[6] DR is currently the leading cause of blindness in the working age population world-wide,[7] and it is estimated that approximately one third of persons living with diabetes will have DR at any given time.[8] Vision impairment from this cause may lead to a loss of livelihood affecting not only workers, but also the families and communities who depend on them economically.

Timely laser treatment reduces the risk of severe vision loss from proliferative DR by 90%.[9] As affected individuals commonly remain asymptomatic until late in the disease process, effective DR screening programs are vital in delivering timely treatment and preventing unnecessary blindness. Those who do not attend screening regularly are at four-fold increased risk of sight-threatening diabetic retinopathy (STDR) compared with patients screened annually.[10] The cost-effectiveness of screening has been well-established,[11] and countries such as the United Kingdom with established national screening programs have successfully eliminated DR as the leading cause of working age blindness.[12]

The majority (66.7% in urban and 81.1% in rural areas)[13] of people with diabetes in China fail to receive annual eye examinations as recommended by the American Academy of Ophthalmology Preferred Practice Patterns,[14] which have been formally adopted in China.[15] Furthermore, 43.2% and 68.7% of those with diabetes in urban and rural areas respectively have never had an eye examination.

Barriers to DR screening in China include patients' lack of disease knowledge and failure of physicians to recommend eye examinations.[13] Mobile health (mHealth) interventions have the potential to address both of these issues.[16] The World Bank estimates the number of mobile phone subscriptions per 100 people at 98.6 worldwide and 93.2 in China,[17] making Short Message Service (SMS) informational reminders an attractive method for improving knowledge and screening attendance in this setting. Recent studies of mHealth in the eye care sector have been successful in significantly increasing uptake of care for conditions such as pediatric cataract[18] and glaucoma.[19]

Recent reviews of the effect of SMS interventions on attendance rates have included studies from both diabetes and ophthalmology clinics.[20-22] However, few published trials follow a randomized-controlled design and none so far have assessed impact on DR attendance rates or focused on low income countries.[23-27] The aim of the current report is to investigate the impact of SMS informational reminders on adherence with scheduled eye examinations (primary outcome), knowledge about DR and satisfaction with care (secondary outcomes) among patients receiving

diabetic care in a network of rural government hospitals in China. The study hypothesis was that informational reminders would significantly increase all of these parameters.

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Methods

The protocol for this study was approved in full by the Ethics Committee of the Zhongshan Ophthalmic Center, Sun Yat-sen University (Guangzhou, China) and registered at the US National Institutes of Health (ClinicalTrials.gov) website, #NCT01837121.Written informed consent was obtained from all participants, and the tenets of the Declaration of Helsinki were followed throughout.

Trial Design

This was a multicenter, randomized (1:1 ratio), investigator-masked study conducted in low-income areas of Guangdong Province, China. The 5 hospitals participating in this study were part of the Comprehensive Rural Eye Service and Training (CREST) network in Guangdong Province (per capita Gross Domestic Product[GDP]: US$10,565 in 2015),[28] a collaboration between Orbis International (a US-based eye health non-governmental organization) and the Zhongshan Ophthalmic Center (Guangzhou, China). They were located in Shaoguan (population:3.29 million, 2015 per capita GDP: US$5,038), Chenghai (population: 0.75 million, 2015 per capita GDP: US$4,377), Luoding (population:1.25 million, 2015 per capita GDP: US$2,200), Huidong (population: 0.86 million, 2015 per capita GDP: US$5,960) and Jieyang (population: 6.95 million, 2015 per capita GDP: US$3,840).[28]

Participants

Between 1 March 2015 and 31 May 2016, consecutive diabetic patients attending eye clinics at the above locations were recruited to the trial. Patients who were known to have diabetes mellitus (defined by WHO criteria[29]), or for whom the diagnosis was made at the time of the eye examination based on characteristic fundus findings, were eligible for the study. Participants were required to own a mobile phone capable of receiving text messages and be literate, or assisted by relatives or neighbors if illiterate. Those whose scheduled follow-up date fell outside of the study timeframe, or who were determined to require laser or incisional therapy at the time of their initial examination, were excluded.

Randomization

After obtaining written informed consent and baseline information from eligible patients, doctors/nurses from participating clinics registered participants on the CREST network's Electronic Medical Records (EMR) system (CSIRO, Perth, Australia). This system automatically allocated patients to the Intervention or Control group by block randomization in a 1:1 ratio, using separate online-generated randomization sequences (http://www.randomization.com) for each hospital and a block size of 6. All nurses, doctors and researchers were masked to the randomization sequence and patients' allocation.

Visual acuity measurement and DR grading

At the baseline and endline visits, measurement of visual acuity (un-corrected and best-corrected) was carried out using a logarithm of the Minimum Angle of

Resolution (logMAR) chart by nurses. Participants also underwent a fundus examination by a trained local ophthalmologist with dilation of the pupil. In all cases, a slit-lamp with a 90D lens was used, and indirect ophthalmoscopy with a 20D lens was also employed at the discretion of the examiner.

DR grading was based on United Kingdom National Diabetic Eye Screening Program (NDESP) guidelines, and follow up appointments were planned according to NDESP recommendations.[30] For example, patients graded as R0 (no DR) were scheduled to return after 12 months, those with R1 (background DR) and R3s (stable treated proliferative DR) after 6-12 months, and R2 (pre-proliferative DR) after 3-4 months.

Interventions

In addition to being informed of their re-attendance date at the initial visit, as were those in the Control group, participants in the Intervention group also received SMS reminders at 1 week and 3 days prior to their scheduled appointments. Both SMS messages also included information on the asymptomatic nature of DR and the need for regular eye examinations. Members of the Control group received only oral reminders of their re-attendance dates from hospital staff at the time of their initial visit.

These reminders, costing US$0.02 per message, were sent automatically to the patient's cell phone up to three times, until noted automatically by the system as having been as having been received. If three SMS reminders were not received by the patient, messages were directed to a relative designated at the time of enrollment up to a total of three times. The total setup cost of equipment (computers, server), software development and internet across the CREST network totaled s US$5.38/patient among 1800 patients over the time of this study.

Outcome assessment and data collection

The primary study outcome was attendance within 1 week of the scheduled visit. This was assessed by comparing the scheduled and actual revisit dates as recorded in the hospital EMR system, and checking against hand-written clinical notes. Both sources had to indicate that the patient had attended the appointment within the allotted timeframe for a positive attendance outcome to be recorded. Secondary outcomes included change in best-corrected visual acuity in the worse-affected eye, change between baseline and endline scores on knowledge about DR (including five multiple-choice questions concerning diagnosis, prevention and treatment of DR/DM; total score ranged from 0 to 5, with a higher score indicating better knowledge) and satisfaction with care (consisting of three questions about the level of service provided, professionalism of caregivers and the hospital environment; total score ranged from 3 to 15, with a higher score indicating better satisfaction.) These questionnaires were administered by nurses at the eye clinics.

At the initial visit, participant baseline demographic information was also obtained by nurses using a questionnaire, which also included clinical history, including the number of years since diabetes was first diagnosed, current medical

regimen and any previous treatments for DR. Participants were also asked to rate their health status on a five-point scale (1=excellent to 5=poor).

Patients failing to return within a week of the scheduled appointment provided data for the primary outcome, and were contacted by telephone and asked to return to hospital for examinations and to gather data for the secondary outcomes. For participants who did not return to hospital, knowledge and satisfaction questionnaires were completed by phone if possible.

Sample size and statistical methods

The study was designed to enrol 230 participants, resulting in 90% power at a 2-sided α of 0.05 to detect a difference in attendance rates between groups of 10 vs. 30%, with an estimated 20% loss to follow-up. Results were presented as mean (SD, standard deviation) or median (IQR, inter quartile range) for continuous data and number (frequency) for categorical data. We estimated family wealth by summing the value, as reported in the China Rural Household Survey Yearbook (Department of Rural Surveys, National Bureau of Statistics of China, 2013), of household items owned by the family from a previously-defined list of 13 common objects. The differences between study groups (and associated 95% CIs) in the observed proportion of subjects presenting within one week of their scheduled follow-up date were calculated by performing a two-proportion z-test. Baseline demographic and clinical characteristics of participants were compared between study arms using the two-sample t test for age and self-rated health, Chi-square test or Fisher's exact test for binary variables with two levels and ordinal logistic regression for family wealth, which was transformed into an ordinal categorical variable with three levels.

Study group, age, sex and all variables significant with $p<0.05$ in the simple regression analysis were included in the multiple regression model. We used generalized linear models with Poisson regression to estimate the relative risk associated with membership in the Intervention group, and with other potential determinants. To detect group differences in secondary outcomes, the Wilcoxon rank-sum test was used for best-corrected visual acuity and the two-sample t-test for DR knowledge and patient satisfaction scores, with differences (endline - baseline) as the outcome for all. All statistical analyses were performed using a commercially available software package (Stata 13.1, StataCorp, College Station TX, USA).

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Results

Among 237 consecutive DM patients assessed for eligibility, 4 (1.68%) required laser or incisional therapy at their initial visit were therefore excluded from the study. No patients were excluded for failure to own a mobile phone. Of 233 (98.3%) patients enrolled to the study, 119 (51.1%) were randomized to the Intervention group and 114 (48.9%) to Control. (Figure 1)

A higher proportion of the Intervention group had previously undergone dilated fundus examinations (Intervention n=35 [29.4%] vs Control n=18 [15.8%]), p=0.013). Otherwise, there were no significant differences between the randomisation groups at baseline. (Table 1) All study participants received their allocated intervention and provided information on the main trial outcome (follow-up within +/- 1 week of the scheduled visit). Information on the secondary outcomes were available for 105 participants (88.2%) in the Intervention group and 101 (88.6%) Controls. (Figure 1)

Attendance was higher in the Intervention group (51/119=42.9%) compared with Controls (16/114=14.0%], difference [95% CI], 28.8% [17.9%, 39.8%], p<0.001). Factors associated with the scheduled follow-up in multiple regression models included membership in the intervention group (Relative Risk [RR], [95% CI], 3.04 [1.73, 5.33], p<0.001) and baseline DR knowledge score (1.47[1.21, 1.78], p<0.001) whereas age, sex, educational level, travel time, baseline uncorrected visual acuity in the more severely-affected eye, previous dilated fundus examination and baseline patient satisfaction score were not significantly associated with attendance at the follow-up examination. (Table 2)

Regarding secondary outcomes in the trial, the difference in DR Knowledge score between baseline and endline was significantly greater in the Intervention group compared to Controls (Mean difference [95% CI], 1.30 [0.96-1.63], p<0.001). Similarly, change in patient Satisfaction score between baseline and endline was greater in the Intervention group (Mean difference 1.08 [0.70-1.46], p<0.01). No significant difference was found in change in best corrected visual acuity from baseline between the randomisation groups. (Table 3)

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Discussion

Attendance rates at rural diabetic eye clinics were significantly improved in Intervention compared to Control participants using low-cost informational SMS reminders. Knowledge at baseline about DR was also a significant predictor of clinic attendance, consistent with previous research in urban China,[31] where diabetes education within the previous year more than doubled the odds of compliance with offered DR screening.

Informational SMS reminders in the current study also significantly improved patient satisfaction and DR knowledge in the Intervention group as compared to Controls. Although previous trials of SMS reminders have not assessed these outcomes, it has been reported that improved communication with doctors is associated with higher patient satisfaction in China[32] and a study in the United States showed that health literacy was directly related to the quality of physician-patient communication.[33] This is consistent with our finding that communication in the form of SMS informational reminders improved health knowledge. Other studies outside China have shown that SMS informational reminders not only increase disease knowledge among patients with diabetes, but also improve clinical outcomes such as HbA1c and lipid profile.[34,35] Across LMICs, randomized trials in various disease settings, including a post-operative clinic in Kenya,[23] primary care settings in Malaysia,[24,25] a health promotion centre in China[26] and a mental health clinic in Nigeria,[27] have shown text messaging reminders to be effective in improving attendance rates. In these studies, simple text messaging reminders were compared against no reminders, with the exception of Odeny et al.,[23] in which post-operative instructions were also included. Pooled analysis from these studies 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 (I^2 = 13%).

Our finding that SMS reminders can increase adherence with eye care in low-income areas of China is also consistent with previous eye care trials. Follow up after pediatric cataract surgery[18] and trabeculectomy surgery for glaucoma[19] increased by 47% and 65%, respectively. By contrast, a systematic review by Gurol-Urganci et al found that mobile text message reminders led to a modest increase in attendance rates at healthcare appointments when compared to no reminders (RR 1.14, 95% CI 1.03, 1.26).[36] This review did not include all of the above positive trials. A possible further reason for the greater success in the current study may have been the inclusion of healthcare information designed to reinforce the need for and benefits of screening for DR. Previous studies in nearby settings in southern China have demonstrated the failure of educational messaging alone to improve attendance at comprehensive eye examinations,[37] acceptance of cataract surgery[38] and purchase of children's spectacles.[39] It seems likely that multi-faceted interventions, such as combining educational and reminder interventions in the current study, are more effective in producing desired health behaviours in this setting. The successful trial of Yang et al on post-trabeculectomy follow-up[19] also combined another intervention (free post-operative medications) with SMS reminders.

SMS reminders at US$0.02 per message represent an inexpensive method of improving patient attendance. Including expenditures associated with establishing an

EMR system with automated messaging functionality, the full cost per patient over the life of the project was only slightly more than US$5. This figure will tend to decrease over time and with larger networks. High rates of mobile phone ownership in China, even in under-served areas, add to the attractiveness of this intervention. All patients in the current study owned phones capable of receiving an SMS reminder, consistent with rates of 90-99%[18-19] reported in similar low-income areas of southern China. Establishing an EMR system with automated messaging function in the clinic to manage DR patients and send reminder messages appears sustainable in this and similar low-resource settings.

Strengths of this study include the randomized controlled design, and high rates of patient enrolment, fidelity to protocol and follow-up for the main study outcome. The selection of rural and other low-income areas in China is also highly relevant, in view of the low reported rates of accessing diabetic eye care in this setting,[13] and the rapidly-rising prevalence of diabetes in China.[3-5]

Weaknesses of the study include the relatively small number of hospitals within the CREST network, all of which lie within a single province in China, which limits generalization to other settings. Not all patients received indirect ophthalmoscopy with a 20D lens, meaning that retinopathy could not be ruled out with certainty even in the presence of a normal macular examination. We do not believe that the modest potential under-ascertainment of cases which would have resulted from this would greatly affect our results regarding the impact of our intervention on compliance, but this cannot be stated with certainty. At baseline, participants in the Intervention Group were significantly more likely to have had a prior dilated fundus examination than were members of the Control Group. It is thus possible that participants in the Intervention Group were at baseline more disposed to accepting ocular examinations, though adjustment for history of such examinations did not diminish the association between study group and our main outcome, and in fact a prior history of examinations at baseline was not significantly associated with accepting study exams (Table 2). Most importantly, although the intervention significantly improved patient attendance, adherence in the Intervention group was still not adequate: fewer than half of patients complied with suggested eye care appointments. It is likely that richer interventions with even more components are needed to achieve better acceptance of eye care in this setting. We are now carrying out a trial of an intervention including SMS informational reminders, diabetes clubs and financial incentives (mobile phone top-ups) on a population-based cohort of rural-dwellers with diabetes in Guangdong, China. Additional research is needed in this area, as improving long-term adherence with care of non-communicable diseases remains a major challenge in low-resource settings.

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Acknowledgments/Disclosure:

Funding/Support: This study was supported by Orbis International, New York, USA, the Fred Hollows Foundation (FHF), Sydney, Australia and the World Diabetes Foundation (WDF), Copenhagen, Denmark, [grant number: WDF12-705]. Prof. Congdon is supported by a Thousand Man Plan award from the Chinese government, and by the Ulverscroft Foundation, UK. The sponsor or funding organization had no role in the design or conduct of this research.

Financial disclosures: No financial disclosures.

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Figure captions

Figure1: Enrolment of patients into a Trial of Short Messaging System (SMS) Informational Reminders to Improve Adherence with Schedule Eye Care Visits among Rural Chinese Patients with Diabetes

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Statement

Each of the co-authors has seen and agrees with each of the changes made to this manuscript in the revision and to the way his or her name is listed

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Table 1. Baseline characteristics of participants

Characteristic	SMS group (n=119, 51.1%)	Control group (n=114, 48.9%)	P-value[a]
Demographic Characteristics			
Age (years), Mean (SD)	59.7 (11.3)	58.7 (9.50)	0.445[d]
Male sex, n (%)	62 (52.1)	56 (49.1)	0.649[e]
Education, n (%)			0.621[e]
Less than high school	81 (68.1)	81 (71.1)	
High school or above	38 (31.9)	33 (28.9)	
Family wealth, USD, n (%)[b]			0.790[f]
Bottom tercile	37 (31.1)	39 (34.2)	
Middle tercile	22 (18.5)	18 (15.8)	
Top tercile	60 (50.4)	57 (50.0)	
Accompanying friend or family member present, n (%)			0.677[e]
Yes	47 (39.5)	42 (36.8)	
No	72 (60.5)	72 (63.2)	
Travel time from home to hospital, hours, n (%)			0.844[e]
<=0.5	88 (73.9)	83 (72.8)	
>0.5	31 (26.1)	31 (27.2)	
Payment for follow-up visit, n (%)			0.811[e]
Self-pay	66 (55.5)	65 (57.0)	
Insurance	53 (44.5)	49 (43.0)	
Clinical Characteristics			
Known diabetes history, n (%)			0.659[e]
Yes	116 (97.5)	110 (96.5)	
No	3 (2.52)	4 (3.51)	
Time since diabetes diagnosis, years, n (%)			0.799[e]
<10	75 (63.0)	70 (61.4)	
>=10	44 (37.0)	44 (38.6)	
Previous diabetes treatment, n (%)			0.312[e]
Insulin injection or oral medication	100 (84.0)	101 (88.6)	
Exercise, diet or no treatment	19 (16.0)	13 (11.4)	

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Previously received treatment for diabetic eye disease, n (%)			0.255[g]
Yes	9 (7.56)	4 (3.51)	
No	110 (92.4)	110 (96.5)	
Previous fundus exam with dilated pupil, n (%)			0.013[e]
Yes	35 (29.4)	18 (15.8)	
No	84 (70.6)	96 (84.2)	
Self-rated health status (1=Excellent-5=Poor), Mean (SD)	3.43 (0.99)	3.56 (0.85)	0.274[d]
Uncorrected visual acuity in the more severely-affected eye, LogMAR, median (IQR) [c]	0.50 (6/12) (0.30-0.80)	0.50 (6/12) (0.30-0.80)	0.534[h]
DR grading in higher DR grade eye, n (%)			0.272[g]
R0	64 (53.8)	64 (56.1)	
R1	46 (38.7)	47 (41.2)	
R2	9 (7.56)	3 (2.63)	
DME grading in either eye, n (%)	2 (1.68)	0 (0.00)	0.498[g]

Abbreviations: SMS =Short Message Service, SD=Standard Deviation, 1USD=7.00RMB, DR=Diabetic Retinopathy, DME=Diabetic macular edema

a. Comparing the two study groups.

b. Family wealth was calculated by summing the value, as reported in the China Rural Household Survey Yearbook (Department of Rural Surveys, National Bureau of Statistics of China, 2013)

c. In the eye with the higher DR grade having worse vision

d. Two-sample t-test

e. Chi-square test

f. Ordinal logistic regression

g. Fisher's exact test

h. Wilcoxon rank-sum test

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Table 2. Intention to treat analysis of potential predictors of adherence with scheduled eye examinations (main outcome) among participants (N=233)[a]

	Simple regression (n=233)		Multiple regression[b] (n=233)	
	Relative Risk (95% CI)	P-value	Relative risk (95% CI)	P-value
Intervention (SMS)Group (Control as reference)	**3.05 (1.74, 5.35)**	**<0.001**	**3.04 (1.73, 5.33)**	**<0.001**
Demographic Characteristics				
Age, per year	1.01 (0.99, 1.04)	0.343	1.01 (0.99, 1.03)	0.373
Male sex	0.84 (0.52, 1.36)	0.474	0.68 (0.41, 1.11)	0.124
High school or above education	1.04 (0.62, 1.75)	0.877		
Family wealth, USD (Bottom tercile as reference)				
Middle tercile	1.27 (0.61, 2.63)	0.526		
Top tercile	1.34 (0.76, 2.35)	0.314		
Has accompanying friend or family member	1.09 (0.67, 1.78)	0.723		
Lives >=half hour from hospital	1.16 (0.66, 2.03)	0.614		
Self-pay for follow-up visit	0.85 (0.53, 1.38)	0.511		
Baseline Clinical Characteristics				
Known diabetes history	0.66 (0.21, 2.10)	0.483		
Diagnosed with diabetes>10 years ago	0.92 (0.56, 1.52)	0.742		
Previous treatment with insulin or oral medication	0.73 (0.39, 1.36)	0.323		
Previous treatment for diabetic eye disease	1.07(0.39, 2.95)	0.889		
Previous fundus exam with dilated pupil	1.07 (0.61, 1.87)	0.825		
Uncorrected visual acuity in more severely-affected eye, LogMAR	1.31 (0.56, 3.06)	0.534		
DR grade in more severely-affected eye (R0 as				

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reference)				
R1	1.04 (0.64, 1.70)	0.871		
R2	0.58 (0.14, 2.39)	0.448		
Self-rated health situation	0.95 (0.74, 1.23)	0.684		
Patient attitude/knowledge				
Baseline DR knowledge score (range 0-5, higher score = better knowledge)	**1.47 (1.23, 1.77)**	**<0.001**	**1.47 (1.21, 1.78)**	**<0.001**
Baseline patient satisfaction score(range 3-15, higher score =better satisfaction)	**1.18 (1.00, 1.39)**	**0.048**	1.19 (1.00, 1.42)	0.054

Abbreviations: CI=Confidence Interval, SMS=Short Message Service, LogMAR=Logarithm of the Minimum Angle of Resolution, DR=Diabetic Retinopathy

a. Generalized linear models with Poisson regression was used to estimate the relative risk forthe follow-up compliance.

b. Age, sex and variables in the simple regression significant at the $p<0.05$ level were included in the multiple regression.

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Table 3. Change in Patient Characteristics (Visual acuity, DR grade, DR Knowledge Score and Patient Satisfaction Score) over the period of follow-up[a]

	Baseline		Follow-up		Comparing the change from baseline between groups		
	SMS group	Control group	SMS group	Control group	SMS group	Control group	P-value[f]
Best corrected visual acuity(BCVA), LogMAR, median (IQR)[b]							
BCVA in eye with higher DR grade, or the same DR grade with WORSE vision	0.15 (0.00-0.30)	0.10 (0.00-0.30)	0.10 (0.00-0.30)	0.10 (0.00-0.30)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.223
BCVA in eye with higher DR grade, or the same DR grade with BETTER vision	0.10 (0.00-0.22)	0.10 (0.00-0.22)	0.10 (0.00-0.22)	0.10 (0.00-0.22)	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.121
DR Knowledge Score, patient satisfaction score, mean (SD)[c]							
DR Knowledge Score, (range1-5, higher score = better knowledge)[d]	1.01 (1.06)	0.89 (1.13)	2.76 (1.44)	1.35 (1.28)	1.75 (1.40)	0.45 (1.10)	**1.30 (0.96-1.63)[g] <0.001**
Patient satisfaction score, (range 3-15, Higher score = better satisfaction)	6.59 (1.39)	6.61 (1.47)	7.09 (1.30)	6.05 (1.04)	0.53 (1.34)	-0.55 (1.54)	**1.08 (0.70, 1.46)[g] <0.001**

Abbreviations: SMS =Short Message Service, LogMAR=Logarithm of the Minimum Angle of Resolution, SD=Standard deviation, IQR=Inter quartile range, DR=Diabetic Retinopathy, DME=Diabetic macular edema.

a. DR grading used the United Kingdom National Diabetic Eye Screening Programe (UK NDESP) grading framework.[26]

b. 27 participants who were lost to follow up had missing data.

c. Among 27 participants who were lost to follow up, 15 participants finished the endline questionnaire by telephone and 12 participants had missing data.

d. DR Knowledge Score was based on 5 true-false questions about early DR diagnosis, prevention and treatment, 1 point awarded for each correct answer.

f. Two-proportion z-test was used for DR grading to detect group differences, with endline data as outcome and controlling for baseline data;
Exact logistic regression was used for DME grading to detect group differences, with endline data as outcome and controlling for baseline data;
Wilcoxon rank-sum test was used for best-corrected visual acuity, with differences (endline– baseline) as outcome;

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Two-sample t test was used for DR Knowledge Score and patient satisfaction, with differences (endline– baseline) as outcome.
g. Mean of the difference between groups and 95% confidence interval was presented.

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