Reinforcement of Adherence to Prescription Recommendations in Asian Indian Diabetes Patients Using Short Message Service (SMS)-A Pilot Study


Abstract

Objectives: To investigate the acceptability and feasibility of using short message services (SMS) via cell phones to ensure adherence to management prescriptions by diabetic patients.

Methods: Type 2 diabetic patients with 5 or more years of diabetes and having HbA1c between 7.0% to 10% were randomized to the control arm (n=105) to receive standard care and to the intervention arm (SMS, n=110). Messages in English on principles of diabetes management were sent once in 3 days, the contents and frequencies varied as per the patients’ preferences. The study duration was 1 year. All participants were advised to report for quarterly clinic visits. A comparative assessment of the clinical, biochemical and anthropometric outcomes was made among the groups at the annual visit.

Results: Annual review was possible in 71% of intervention group and 63% of control group. SMS was acceptable to the patients and the median number requested was 2 per week. HbA1c and plasma lipids improved significantly in the SMS group.

Conclusions: The pilot study showed that frequent communication via SMS was acceptable to diabetic patients and it helped to improve the health outcomes.

Introduction

Patients with diabetes, have a key role in the management of the disease as they are primarily responsible for their day to day health care. They need constant motivation by the health care provider to ensure adherence to the prescriptions which include drugs, diet, physical activity and habits. Availability of mobile internet access is advancing rapidly and mobile phones are used widely by most people. A few pilot studies have demonstrated the efficacy of Short Messaging Service (SMS) delivered interventions in producing better diabetes self-management outcomes.1-5

Patients at our diabetes centre are given education on self-management of diabetes and are also advised for periodic clinic visits for monitoring the health care status. This pilot study was taken up to test the feasibility of producing behavioral changes in type 2 diabetic patients, enabling improved adherence to the prescribed management regimen, using SMS as a tool of communication. The acceptability of SMS by the diabetic patients was also tested.

Material and Methods

The primary aim was to assess whether SMS via cell phones could motivate patients with diabetes to improve adherence to the treatment prescriptions, which included enhanced physical activity, diet modifications and use of drugs. The secondary aim was to study whether such behavioural changes could improve health outcomes measured as HbA1c, other glycaemic measures and lipid profile.

Study Design

Type 2 diabetic patients of both sexes receiving either oral hypoglycaemic agent (OHA) and/or insulin in the age group of 30 to 65 years with a minimum duration of 5 years were recruited. Only patients who could read English, with a minimum of high school education were selected. Subjects with HbA1c value ranging between 7.0% to 10.0% were selected.

Patients who were not able to read or receive SMS, due to poor eye-sight unwilling to participate in clinical trials and those who were unable to make clinic visits at 3 months intervals were excluded.

Consecutive patients, who satisfied the inclusion-exclusion criteria were enrolled. The study was approved by the Ethics Committee of the institution. A written informed consent was obtained from the participants at the baseline visit. Since this was a pilot study, sample size calculation was not made. A total of 215 subjects being treated as outpatients were selected and were randomized either to receive SMS (n=110) or assigned to control group (n=105) using a computer-generated random number. Patients in the control group received standard care which included appropriate prescriptions of drugs based on the clinical and laboratory investigations and advice on diet modification and physical activity. The intervention group received SMS once in 3 days as a reminder to strictly follow the regimen of dietary modification, physical activity and drug schedules. Both groups were advised to report for clinic reviews at quarterly intervals. The total number of clinic visits required was 5, during the one year study.

SMS Contents

Messages, written in English consisted of varied instructions on medical nutrition therapy (MNT), physical activity, reminders...
Table 1: Frequency of SMS as preferred by study participants

<table>
<thead>
<tr>
<th>SMS Contents</th>
<th>Frequency / Year</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Range</td>
</tr>
<tr>
<td>General</td>
<td>16-90</td>
</tr>
<tr>
<td>Diet</td>
<td>8-99</td>
</tr>
<tr>
<td>Complications</td>
<td>3-74</td>
</tr>
<tr>
<td>Physical Activity</td>
<td>3-60</td>
</tr>
<tr>
<td>Drugs</td>
<td>1-4</td>
</tr>
<tr>
<td>Total</td>
<td>37-286</td>
</tr>
</tbody>
</table>


Investigations

All patients had attended patient education programme, during the initial and follow up visits to the clinic. Advice on MNT, physical activity and drug intake had been given individually, at each visit.

For each participant, physical activity, diet habits and adherence to drug prescriptions were assessed using a validated questionnaire, at randomization (baseline) and during each clinic visit. The level of physical activity was assessed based on scores given for occupational and leisure time activities. Dietary adherences were assessed based on scores given for components of healthy diet and frequency of adherence to the same. Patients were requested to maintain a diary to note the deviations in physical activity, diet or drug per week which was quantified at the clinic visits.

At each visit body weight, waist circumference (WC), blood pressure (BP), fasting plasma glucose (FPG) and 2h post prandial plasma glucose (2h PG) (Hexokinase method), HbA1c (Immunoturbidimetry method) and compliance to the prescriptions were assessed. Blood pressure was also measured. Body Mass index (BMI, kg/m²) was calculated. Levels of serum total cholesterol (TC), LDL cholesterol (LDL-C), HDL-cholesterol (HDL-C) and triglycerides (TG) were measured at the baseline and at 12 months using enzymatic procedures. Biochemical tests were done using Roche-Cobas 411 autoanlyser.

Data Analysis

Data analysis was done at the end of the study after completion of one year. Baseline and final data were compared. Body weight, blood pressure, biochemical variables, scores for diet and physical activity and compliance to drugs, were compared using Student’s t’ test or χ² test as relevant. For skewed variables such as triglycerides, median values are shown and Mann-Whitney test was used for comparisons.

Results

The baseline characteristics were similar in the control and SMS groups. Baseline age, BMI and HbA1c (%) in control and SMS groups in respective order were as follows. Age (years): 50.5 + 8.3 and 50.1 + 9.9, BMI(kg/m²) 27.7+ 5.3 and 27.3+3.9, and HbA1c(%) 9.1 +1.4 and 8.9+ 1.3. In the control and SMS group, 34.3% and 33.6% were using OHA+insulin respectively. Hypertension was present in 41% of the control and 42.7% of SMS groups.

Majority of the patients in the SMS group preferred to receive messages on all aspects of treatment. Messages on general health tips and MNT were mostly preferred (Table 1).

Acceptance of SMS

At the time of randomization, patients assigned to the SMS group were explained about the contents of the messages and their preferences of the types of messages were noted. A few patients changed the preferences at the interim visits. The SMS as a tool for reminders about treatment principles were highly acceptable to the patients, as seen from the number of messages and their frequency requested by the patients. The median frequency of SMS was 2 per week. Maximum number of patients preferred to get messages on general health care and dietary principles, followed by information on complications and physical activity (Table 1).

Frequency of Visits

In the SMS group 78 out of 110 (71%) came for the annual follow-up. In the control group 66 out of 105 (63%) reported for annual check-up. At this period, SMS group showed slightly higher rate than the control group, but the difference was statistically non-significant. The third month follow-up was attended by 68% of the SMS group and 75% of the control group. The percentage of patients attending the subsequent three month visits decreased in the 6th (control 57%, SMS 46%) and the 9th month (control 46%, SMS 45%). There was no statistical difference in the proportion of the SMS and control groups reporting for the follow-up, at any point of time. The baseline characteristics of the responders and nonresponders for the annual visit were similar.

Adherence to Prescriptions

Diet: At the baseline, adherence to diet prescriptions was satisfactory in 54.5% and 60.3% in the control and SMS groups respectively. At the annual visit, no significant change was seen in either group (control 52%, SMS 58.4%). The intergroup difference was not significant at these time points.

Physical Activity: In the control group, compliance to the advice was noted in 47% and 52% during the baseline and 1st year visits respectively. In the SMS group the adherence improved marginally from 47% to 56% and the change was statistically non significant.

Drug prescriptions were followed satisfactorily by both groups.

Comparison of outcomes at the end of 1year:

At the end of one year, the mean FPG (185+57 mg/dl to 166+ 54, p=0.002) and 2h PG 263 + 84 mg/dl to 220 + 67, p <0.002) levels decreased significantly in the SMS group. There was no significant difference in the mean HbA1C values in both groups. Serum TC decreased significantly in both groups (Control, 175+ 47 mg/dl to 164+ 38 mg/dl, p<0.03 and SMS,179+ 42 mg/dl to 164+ 31 mg/dl, p=0.03).

The results at the annual visits were analysed separately in subjects with obesity, severe hyperglycaemia and lipid abnormalities at the baseline. The changes in BMI and biochemical variables are shown in Table 2. There was no significant difference in the percentage of obesity among the
patients in either group. Percentage of patients with abnormal glycaemic parameters decreased significantly at the 1st year in the SMS group as shown by lower percentages having high 2h PG and HbA1c values at the followup, in contrast to non significant changes in the control group (Table 2). Percentage with high LDL-C decreased significantly in both groups. In the SMS group, improvement was also seen in the percentage having hypertriglyceridaemia.

**Table 2 : Comparative analysis of the outcomes – Improvement in anthropometry and biochemical variables**

<table>
<thead>
<tr>
<th></th>
<th>Control (n=66)</th>
<th>SMS (n=78)</th>
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<tbody>
<tr>
<td></td>
<td>Basal 1st Year</td>
<td>Basal 1st Year</td>
</tr>
<tr>
<td><strong>BMI &lt; 25 kg/m²</strong></td>
<td>n %</td>
<td>n %</td>
</tr>
<tr>
<td>21</td>
<td>31.8 19</td>
<td>28.8 24</td>
</tr>
<tr>
<td>9</td>
<td>13.6 13</td>
<td>19.7 11</td>
</tr>
<tr>
<td>11</td>
<td>14.1 27</td>
<td>34.6**</td>
</tr>
<tr>
<td><strong>PPG &lt;180 mg/dl</strong></td>
<td>n %</td>
<td>n %</td>
</tr>
<tr>
<td>21</td>
<td>31.8 32</td>
<td>48.5 24</td>
</tr>
<tr>
<td>9</td>
<td>13.6 13</td>
<td>30.8 43</td>
</tr>
<tr>
<td>11</td>
<td>14.1 27</td>
<td>55.1**</td>
</tr>
<tr>
<td><strong>HbA1c &lt; 8%</strong></td>
<td>n %</td>
<td>n %</td>
</tr>
<tr>
<td>53</td>
<td>80.3 61</td>
<td>92.4 62</td>
</tr>
<tr>
<td>44</td>
<td>66.7 53.8</td>
<td>78.8 42</td>
</tr>
<tr>
<td>150 mg/dl**</td>
<td>n %</td>
<td>n %</td>
</tr>
<tr>
<td>44</td>
<td>66.7 53.8</td>
<td>78.8 42</td>
</tr>
<tr>
<td>49</td>
<td>74.2 55.1</td>
<td>55.1 50</td>
</tr>
<tr>
<td><strong>LDL-C &gt;100 mg/dl</strong></td>
<td>n %</td>
<td>n %</td>
</tr>
<tr>
<td>40</td>
<td>60.6 54</td>
<td>81.8 46</td>
</tr>
<tr>
<td>46</td>
<td>59.0 61</td>
<td>78.2**</td>
</tr>
</tbody>
</table>

**Discussion**

The pilot study in a small group of randomized type 2 diabetes patients indicated that reminders related to principles of diabetes management were acceptable to the patients using SMS. Most of them preferred to receive two messages per week. They preferred to receive messages on variety of principles of treatment which included instructions related to general health, MNT and physical activity. At the annual visit, the SMS group had significant reduction in the glycaemic levels, when compared with the corresponding baseline values. The results showed that frequent communication with the health care provider was well accepted by diabetic patients. Behavioural changes relating to lifestyle modification were encouraged by the frequent communication/reminders. This resulted in a better glycaemic outcome in significantly higher percentage of patients receiving the SMS. The differences between the two groups were not statistically significant, probably due to the small sample size. Improvement in lipid profile was seen in both groups. However the changes were seen in a higher percentage of patients in the SMS group. Although there was no significant reduction in the mean HbA1C values in either group, the percentage with A1C<8% decreased significantly in the SMS group. It was important that patients with uncontrolled glycaemia (HbA1C >8.0%) were motivated to comply with doctor’s prescriptions, by the messages. Adherence to MNT improved with the frequent reminders.

The participants in control group were given advice on optimal medical care at each clinic visit. However the beneficial changes in glycaemia and in lipid profile was better in the group who received frequent reminders through short messages. This could be a reflection of the behavioural improvement produced by frequent motivation.

It was noted that more than 50% of the patients in both groups did not comply with the advice for quarterly clinic visits for clinical assessment. It is important to note that although there was a hesitancy to make clinic visits at frequent intervals, reminders by SMS on principles of diabetes management helped to improve the metabolic outcome.

Similar beneficial results had been published in a smaller group of diabetic patients, in a follow-up study of 12 weeks from Korea. A review of 14 published papers targeting preventive health behavior of which ten focusing on diabetes self-management, positive behavior change outcomes were noted in 13 studies. The duration of the present study was longer, than that of the above reports, most of which had duration only of a few weeks.

Frequent interaction between the health care provider and the patients is known to improve outcomes of treatments, by enhancing compliance to the prescriptions. Tools facilitating such interactions need to be cheap, individually tailored, and instantaneously delivered at preferred time and intervals by the recipient and programmable to suit the conveniences of busy doctors or other health care personnel. Studies have recently addressed the effectiveness of interventions delivered via telephone and the internet. In the recent years, mobile telephones are being widely used, even in low income countries, as they are cheap and convenient and short message services have become a popular and cheap mode of easy and widespread communication. Only a few studies have used SMS for improving health behavior in patients with chronic disorders.

The limitation of the study was the small sample size which might have affected the outcomes in subgroup analysis. However, the results suggested positive responses with frequent motivation using SMS which can provide a basis for planning larger studies using the feasibility of using the mode of communication which is cheap and practical.

This pilot study indicated that regular contact and motivation of diabetic patients through SMS improved the metabolic outcome, which was probably due to continuous adherence to behavioural modifications advised. SMS may be more cost effective than other telephone or internet communications and interaction between patient and the provider at desired frequencies is facilitated.

**Author Contributions**

Dr. Ananth Samith Shetty : Researched Data, Contributed to discussion, Reviewed manuscript; Dr. Chamukuttan Snehalatha : Researched and Analysed data, Discussed and Prepared manuscript; Dr. Arun Nanditha : Contributed to discussion, Reviewed manuscript; Dr. Roopesh Jain : Contributed to discussion, Reviewed manuscript; Prof. Ambaddy Ramachandran : Researched and Analysed data, Discussed and Edited Manuscript

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**References**


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**Workshops - APICON 2012 (Kolkata)**

The Scientific Committee APICON 2012 has organized the following workshops during the Conference

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<tr>
<th>Sr. No.</th>
<th>Title</th>
<th>Faculty</th>
<th>Date and Time</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Arterial Blood Gas Analysis</td>
<td>Dr. Trupti Trivedi, Mumbai&lt;br&gt;Dr. Agam Vora, Mumbai</td>
<td>13.01.2012&lt;br&gt;3.00-5.00 pm</td>
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<tr>
<td>2</td>
<td>Ethics in Clinical Trials</td>
<td>Dr. Urmila Thatte, Mumbai&lt;br&gt;Dr. Shantanu Tripathy, Kolkata</td>
<td>13.01.2012&lt;br&gt;3.00-5.00 pm</td>
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<td>3</td>
<td>Achieving success in Chronic Organ Failure</td>
<td>Dr. Deepak Amrapurkar, Mumbai&lt;br&gt;Dr. Ajit Bhagwat, Aurangabad&lt;br&gt;Dr. Rajiv Gandhi, Miraj</td>
<td>13.01.2012&lt;br&gt;3.00-5.00 pm&lt;br&gt;3.00-5.00 pm</td>
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<td>4</td>
<td>Radiology in Chest Disease</td>
<td>Dr Ravi Ramakantan, Mumbai&lt;br&gt;Dr Bhavin Jhankaria, Mumbai</td>
<td>14.01.2012&lt;br&gt;3.00-5.00 pm</td>
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<td>5</td>
<td>Cardiac Arrythmias</td>
<td>Dr Yash Lokhandwala, Mumbai</td>
<td>14.01.2012&lt;br&gt;3.00-5.00 pm</td>
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<td>6</td>
<td>Yoga</td>
<td>Dhyan Foundation, Delhi</td>
<td>14.01.2012&lt;br&gt;3.00-5.00 pm</td>
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Registration fee for each workshop is Rs. 200/- (Rupees two hundred only). Delegates can register for only one workshop per day. Only 100 delegates will be registered per workshop. The registration will be on “First come first serve” basis. Registration fee should be paid directly to the Organizing Committee APICON 2012. For details visit website: apicon2012kolkata.com

**Dr. Sandhya Kamath**

President Elect – API & Chairman Scientific Committee, APICON 2012