Research Article

# Use of Tailored Short Messaging Services to improve Medication Adherence in Patients with Metabolic Syndrome

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**ABSTRACT**

The objective of this study aims to find the effectiveness of use of tailored SMS medication reminders to improve patient medication adherence. An observational study was carried out over a period of 6 months in discharged patients of a tertiary care referral hospital in Kerala. 347 patients were enrolled prospectively from various departments. The subjects were randomized into intervention and control group in 1:1 ratio. Medication adherence was assessed using indirect- subjective patient interviewing method during pre and post intervention phase. From the post-intervention interview it was found that the level of adherence has significantly improved in intervention group (71.4%) compared to the control group (25%). The outcomes of the study revealed that female population (N= 158) is more likely to have metabolic diseases and this might be due to menopause, obesity, lack of exercise, diet and other lifestyles. In this study hypertension was found to be predominant (65.1%) followed by type II diabetes mellitus (55.9%) and dyslipidemia (44.4%). This study demonstrated the effectiveness of use of tailored SMS medication reminders to improve mediation adherence in patients with metabolic syndrome. Text message reminders significantly improve medication adherence and seems to be feasible for clinical use.

**Keywords:** Metabolic syndrome, short messaging services, medication adherence, medication reminders, direct observation, patient interview, pharmacist intervention.

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## INTRODUCTION

Medication adherence is recognized as a significant public health issue, since medication non-adherence leads to poor health outcome and increased healthcare cost. Adherence to treatment strategies is essential for optimizing health outcomes in any disease. According to WHO, Haynes and Rand defined medication adherence as "the extent to which a person's behavior – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider"[1]. Non-adherence is associated with worsening of disease and increased morbidity. Medication non -adherence is a widespread problem that could result in high cost for treatment of medical conditions and its importance is further increased in chronic conditions which requires long-term treatment, where adherence is important to achieve target outcome. Adherence measures can be classified as direct and indirect method of measurement. Some of the direct methods include measuring the level of drug in plasma, urinary excretion data, and measurement of glomerular filtration rate. But it is usually time consuming and expensive and it can be done only on inpatients. Indirect methods include patient questionnaires, patient self-reports, pill counts, rates of prescription refills, assessment of patient's clinical response, assessing medication administration chart, quick review of medication adherence scales[2]. In our study we are using patient questionnaire. Questionnaires[3] are standardized self- reported measure for evaluating adherence to specific medication regimen and can also give additional information about attitudes, behaviors and intentions of the patient. A cut- off point is chosen to differentiate between adherent and non- adherent patients.

The strategies to improve medication adherence comprises enhancing trust and communication, providing drug education, medication therapy management and use of technology. Technology is revolutionizing the healthcare industry. Main technological advances that support medication adherence are mobile health technology, electronic monitors, pill-monitoring technology, online resources & social media. Mobile health technology encompasses text message reminders, smartphone apps, and interactive voice response.

Short Messaging Services (SMS) is a way of sending short written messages from one mobile phone to another. SMS is an abbreviation for 'short message system'. The messages can be up to 160 characters in length. Text Message Reminder (TMR) are available on any mobile device and can be used by all socio-economic groups and ages[4]. Tailored SMS fits the needs of specific individuals. Tailored health-communication messages refer to "any combination of information and behavior

change strategies intended to reach one specific person, based on characteristics that are unique to that person, related to the outcome of interest, and derived from an individual assessment"[5].Study participants may provide individualized preferences regarding time of the day to receive daily SMS medication reminders based on the times of day they take their medications. In one-way SMS communication a text message is sent to a recipient with no expectation or allowance for a response. If the patient is prescribed with more than one medication, a separate text message is sent for each of the medications also participants taking only one medication receive one text message at the time of day they specified. Importance of medication adherence further increases in case of metabolic diseases which require long term treatment with medications along with lifestyle modifications. Studies indicate that the improvement in medication adherence and adherence to lifestyle changes could possibly reduce risk for cardiovascular diseases in patients with metabolic syndrome[6].

## MATERIALS AND METHODS

The study was carried out for a period of 6 months in the year 2021 in KIMS Al Shifa, 750 bedded super specialties tertiary care referral hospital situated in Perinthalmanna, Malappuram district, Kerala. A prospective observational study was carried out in discharged patients with metabolic syndrome, with an objective to evaluate the medication adherence after sending medication reminder SMS to patient or patients 'bystander. A total of 347 patients were enrolled in the study and the study was approved by ethical committee of KIMS Al Shifa super specialty hospital. An official consent was obtained for the purpose of performing the study and it was certified by the Institutional ethics Committee (IEC). The primary aim was to assess the effectiveness of the use of tailored short messages to improve patient medication adherence. The main objectives of this study was to improve medication adherence, determine factors influencing non- adherence and identifying ways to overcome non-adherence.

The subjects were selected based on the proposed inclusion criteria and exclusion criteria submitted to the institution ethics committee (IEC).Inclusion criteria incorporates patients discharged from the hospital with metabolic syndrome. Both male and female patients greater than 18 years old and using mobile phone was enrolled. The study excluded patients having psychiatric disorders and all patients below 18 years age. Also patients from whom informed consent was not obtained were excluded. All the eligible participants with metabolic syndrome were categorized into 2 groups by simple randomization method into case and control group. The case group was provided with patient counseling regarding the importance of medication adherence and collected all the relevant information needed as per data collection form. After the discharge from the hospital, they were provided with tailored short messaging services till the next follow up date. Subjects who were categorized as control did not receive any SMS reminders after discharge from hospital. An interview with control group was carried out to collect information regarding patient medication adherence behavior and information required in the data collection form.

The data was collected from the sources like patient medical records, data collection form, direct interview with patient and drug administration chart. A data collection form was designed to collect information's regarding the patient's medication adherence behavior. The form consisted of the details about patient demography, past medical history, current drugs prescribed and indirect subjective medication adherence measurement which includes particulars concerning the patient interview conducted pre and post intervention. The patients undergone pre interventional phases were evaluated on their review date. The patients were reassessed for their medication adherence using the questionnaire. Direct patient interview or telephonic interview was carried out to evaluate the improvement in adherence. Data were entered into Microsoft Excel and the recorded data were statistically analyzed using Statistical Package for Social Sciences (SPSS) software version 20.0 for WINDOWS. The collected data from participants were analyzed by statistical treatment using appropriate statistical tool.

## RESULT AND DISCUSSION

Of the total 347 patients included in this study, 175 patients were in the case group and 172 patients were in control group. In the control population, 59.9 % (n= 103) of the participants were above 61 years of age, 34.3 % (n= 59) were of age between 41-60years& the remaining belonged to age between 20-40years. In case population, 48 % (n=84) were within age 41-60 and about 46.9 %( n=82) had age of over 61 years. The numbers of female participants was higher than the number of male participants in both case and control groups. 54.5 % (n=189) of the total study population were females. Females constituted 52 % (n=91) of the case group and 57 % (n= 98) of control group.

Of the total 347 subjects in the study, 226 (65.1%) had elevated blood pressure or hypertension of which 118 (67.4%) participants were in case group and 108 (62.8%) participants in the control group. Of the total participants, 194 (55.9%) of study participants had elevated blood sugar. In the case group, 106 (60.6%) participants and 88 participants in the control group (51.2%) participants of the total 172 participants had type 2 diabetes mellitus. 154 (44.4%) participants had elevated blood cholesterol of which 76 (43.4%) participants were in case group and 78 (45.3%) participants in the control group.

By employing scripted interview with each of the study participants, 248 (71.5%) participants responded that they usually forgot to take their medicines, among which 134(76.6%) participants belonged in the case group and 114 (66.3%) participants were in the control group (figure 1).

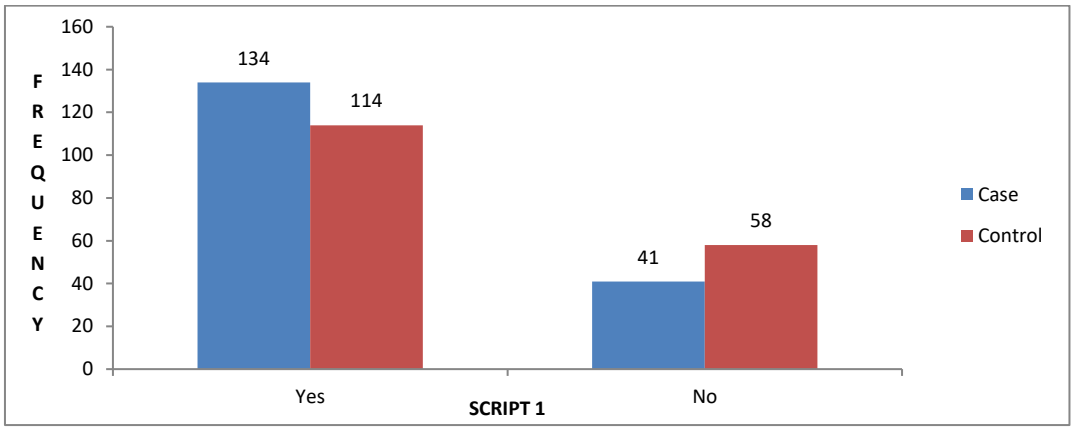


**Figure 1:** Distribution of response to script-1

The most expressed reason for patients to forget their medicine was found to be was forgetfulness. 223 (64.3%) participants reported forgetfulness as the reason to forget to take their medication. The other reasons reported by the participants included work schedule by 59 (17%) participants, lack of symptoms by 35 (10.1%) participants & complex regimen by 30(8.6%) participants (figure 2).

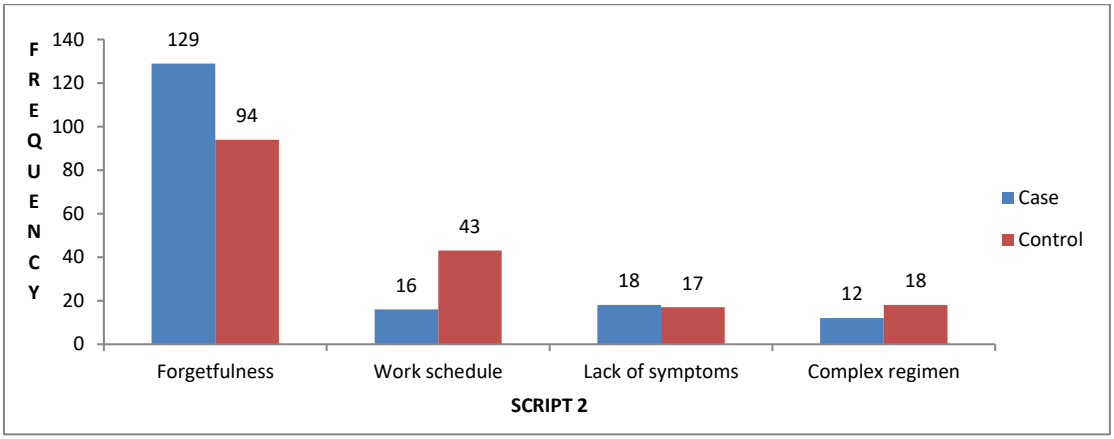


**Figure 2:** Distribution of response to script-2

During the interview, 204 (58.8%) participants said that when they made up for a missed dose. 98 (56%) participants in the case group and 106 (61.6%) participants in the control group reported that they took their dose of medication in some other time, when they missed one dose.

97 (28%) participants reported that the most common difficulty to properly adhere to their medicine was lack of knowledge. In case group, 47 (26.9%) participants and in the control group, 50 (29.1%) participants reported lack of knowledge as the main difficulty. Other difficulties reported was lack of support by 61 (17.6%) participants, low economic status by 52(15%) participants, side effect by 49 (14.1%) participants, lack of benefit by 39(11.2%) participants, poor follow up by 32(9.2%) participants and lack of symptoms by 17(4.9%) participants.On evaluating whether the participants had a tendency to stop their medication when they feel that their condition had been improved or cured, 176 (50.7%) participants reported that they don't, 142(40.9%) participants disclosed that they usually stop their medication and 29(8.4%) participants reported that they occasionally stop their medication when they feel that their condition had been improved or cured. 72 (41.1%) participants in the case group and 70 (40.7%) participants in the control group reported they usually stop their medication when they feel that their condition had been improved or cured.

Determining the opinion of participants on using of SMS as a tool to improve medication adherence, 311 (89.6%) participants presumed it could be a beneficial approach and 36 (10.4%) participants said that it is a useless approach (figure 3).

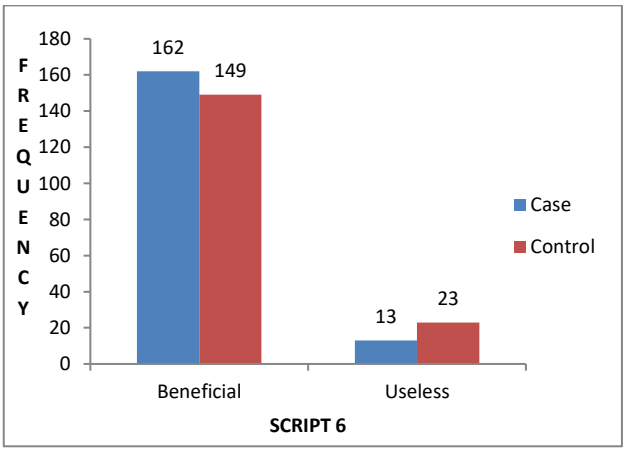


**Figure 3:** Distribution of response to script-6

248(71.5%) participants reported that severity of disease as an important factor that affects medication adherence and 99 (28.5%) participants reported it as ageing. 305(87.9%) participants had a viewpoint that provision of good knowledge about the importance of medication adherence could indeed improve medication adherence. Considered the case and control group separately, 158 (90.3) participants in case group & 147 (85.5%) participants believed so.

The medication adherence before sending reminder SMS (pre-adherence) was categorized into poor, moderate and good adherence. In 175 case study subjects, 114(65.1%) was having poor adherence, 9(5.1%) were having moderate adherence and 52(29.7%) were having good adherence. In 172 control study subjects, 103(59.9%) were having poor adherence, 10(5.8%) were having moderate adherence and 59(34.3%) were having good adherence (table 1).

**Table 1:** Pre-adherence group

| | | | Group | | Total |
|---|---|---|---|---|---|
| | | | Case | Control | |
| PRE -adherence | Good | Count | 52 | 59 | 111 |
| | | % within Group | 29.7% | 34.3% | 32.0% |
| | Poor | Count | 114 | 103 | 217 |
| | | % within Group | 65.1% | 59.9% | 62.5% |
| | Moderate | Count | 9 | 10 | 19 |
| | | % within Group | 5.1% | 5.8% | 5.5% |
| Total | | Count | 175 | 172 | 347 |
| | | % within Group | 100.0% | 100.0% | 100.0% |

On performing person chi square test of pre adherence between case and control group with a df 2 we got the p value 0.599 which is > 0.05 which is statistically insignificant. Similarly the adherence after sending SMS (post adherence) has been categorized into improved no difference and no response. In case study subjects, 125(71.4%) had improved response, 34(19.4%) had no difference and 16(9.1%) didn't respond. Where as in the control group, 43(25%) had improved response, 110(64%) had no difference and 19(11%) didn't respond (table 2).

**Table 2:** Post-adherence group

| | | | Group | | Total |
|---|---|---|---|---|---|
| | | | Case | Control | |
| POST- adherence | Improved | Count | 125 | 43 | 168 |
| | | % within Group | 71.4% | 25.0% | 48.4% |
| | No difference | Count | 34 | 110 | 144 |
| | | % within Group | 19.4% | 64.0% | 41.5% |
| | No response | Count | 16 | 19 | 35 |
| | | % within Group | 9.1% | 11.0% | 10.1% |
| Total | | Count | 175 | 172 | 347 |
| | | % within Group | 100.0% | 100.0% | 100.0% |

On performing person chi square test of post adherence between case and control group with a df 2 we got the p value 0.00 which is < 0.05 which is statistically significant.

On cross tabulation of pre adherence and post adherence, in case group, among the 102 subjects of poor adherence in pre-intervention, 87(85.3%) had improved and 15(14.7%) had no difference in the adherence post-intervention. Among the 9 subjects with moderate adherence, 6(66.7%) had improved and 3(33.3%) has no difference in their adherence post-intervention. Also among the 48 subjects of good adherence, 32(66.7%) had improved and 16(33.3%) had no difference in their adherence post-intervention. Similarly in control group, among the 93 subjects of poor adherence, 31(33.3%) had improved and 62(66.7%) had no difference in their adherence post intervention. Among this 8 subjects of moderate adherence during pre-intervention, 2(25%) had improved and 6(75%) had no difference in their adherence post intervention. 52 subjects of good adherence pre intervention, 10(19.2%) had improved and 42(80.8%) had no difference in their adherence post intervention (table 3).

**Table 3:** Pre -adherence post- adherence group cross tabulation

| Group | | | | POST- adherence | | Total |
|---|---|---|---|---|---|---|
| | | | | Improved | No difference | |
| Case | PRE –adherence | Good | Count | 32 | 16 | 48 |
| | | | % Within PRE -adherence | 66.7% | 33.3% | 100.0% |
| | | Poor | Count | 87 | 15 | 102 |
| | | | % Within PRE -adherence | 85.3% | 14.7% | 100.0% |
| | | Moderate | Count | 6 | 3 | 9 |
| | | | % Within PRE -adherence | 66.7% | 33.3% | 100.0% |
| | Total | | Count | 125 | 34 | 159 |
| | | | % Within PRE –adherence | 78.6% | 21.4% | 100.0% |
| Control | PRE –adherence | Good | Count | 10 | 42 | 52 |
| | | | % Within PRE -adherence | 19.2% | 80.8% | 100.0% |
| | | Poor | Count | 31 | 62 | 93 |
| | | | % Within PRE -adherence | 33.3% | 66.7% | 100.0% |
| | | Moderate | Count | 2 | 6 | 8 |
| | | | % Within PRE –adherence | 25.0% | 75.0% | 100.0% |
| | Total | | Count | 43 | 110 | 153 |
| | | | % Within PRE -adherence | 28.1% | 71.9% | 100.0% |

On performing the person chi-square test of case and control from the cross tabulation of pre adherence with the post adherence with df 2, in case group we got p value of 0.023< 0.05 which is statistically significant and in control group we got p value of 0.190 > 0.05 and is statistically insignificant (table 4).

**Table 4:** Pre -adherence post- adherence group cross tabulation Chi-square tests

| Group | | Value | Df | *p* value |
|---|---|---|---|---|
| Case | Pearson Chi-Square | 7.547[b] | 2 | .023 |
| | N of Valid Cases | 159 | | |
| Control | Pearson Chi-Square | 3.323[c] | 2 | .190 |
| | N of Valid Cases | 153 | | |

An observational study was carried to evaluate the effectiveness of text message medication reminders in improving medication adherence in patients taking medicines for hypertension and/or diabetes and/or dyslipidemia. The data of patients were collected prospectively from various departments like general medicine, cardiology, nephrology, neurology, orthopedics, gastroenterology, pulmonology, gynecology and urology. The medication adherence was assessed using indirect-subjective patient interviewing method. The data were collected from 347 subjects. In this study the SMS intervention significantly improved the medication adherence of participants in the intervention group, who showed a 71.4% increase in the medication adherence compared to only 25% increase in the control group. These findings were similar to those reported by Pandey A, who evaluated the impact of text messaging on medication adherence and exercise among post myocardial infarction patients[7]. The 25% improvement in medication adherence in control group could be due to their increased attention in self-management of their disease. Previous studies have shown that text message reminders were effective in increasing patient attention to treatment and improving medication adherence [8].

The study included a total of 158 (45.5) males and 189(54.5%) females. This shows that the female population is more likely to have metabolic diseases and this might be due to menopause, obesity, lack of exercise, diet and other lifestyles. It was observed that most of the participants had more than one co morbidity. In this study hypertension was found to be predominant (65.1%) followed by type II diabetes mellitus (55.9%) and dyslipidemia (44.4%). Majority of the study participants (53.3%) were above 60 years. This shows that geriatric population was mostly treated for metabolic diseases compared to 41-60 and 20-40 age groups.

From the post-intervention interview it was found that the level of adherence has significantly improved in intervention group (71.4%) compared to the control group (25%). The study showed that 19.4% participants in intervention group and 64% participants in control group showed no difference in medication adherence. This result was similar to those recorded by Amankwaa I et.al [9]. This could be due to either not receiving the SMS medication reminder because of mobile network issues or not being able to see the SMS due to being indulged in routine activities. All the participants were asked about their opinion of using SMS reminders to improve medication

adherence. This approach was perceived to be beneficial by 89.6% participants and useless by 10.47% participants. The study recommends the use of SMS reminders to improve medication non-adherence and also to improve relationship 87.9% of the total study population believed that good knowledge about the importance of medication adherence could positively improve medication adherence. This result was similar to that recorded by Ye Ruan.et.al [10].

## CONCLUSION

This study demonstrated that providing pharmaceutical care by counseling and sending tailored short messaging services to the patients discharged from hospital with metabolic syndrome have demonstrated greater sustainability of adherence rate when compared with the patients who have not received SMS. The result was categorized based on age, sex, medical condition and also was based on the responses provided during counseling. Study clearly explains that the SMS intervention seems to be feasible for clinical use for improving adherence. Text message reminders were found to significantly improve adherence to medications. This study was able to conclude that mobile phone SMS services had the potential to communicate with patients and to build awareness about the disease and medication adherence, improve self management and also to avoid complication in resource limited setting.

### limitations

The major limitation of using SMS reminders in this study is that all patients do not have a mobile phone. Also other patient factors include illiteracy, unfamiliarity with how to view text message, age and word limit of SMS message. The current sample size of this study lacks the statistical power to detect significant change in clinical outcome such as cardiovascular risk reduction or prevention of stroke and other cardiovascular events. Also the 6 months' intervention period is comparable short to ensure long-lasting clinical improvement. The SMS content used in this study was just to remind patients of their medication intake. Close interaction with the patients was not possible at all time consequent to COVID- 19 pandemic situation. Also some patients were reluctant to give consent to receive SMS due to privacy and confidentiality issues.

### Future directions

A similar study can be done for a longer duration and in a large scale population to find the effects of SMS reminders on clinical outcomes. Developing a user-friendly SMS medication reminder application which notifies the time of medication intake would mark a remarkable advancement in medication adherence improvement strategy. Incorporation of native languages, brief information about patient's each medication, and providing a customized two-way communication would further make SMS reminder system more acceptable and effective. The information from this study provides a framework for upcoming studies for investigating the recent approach aimed to improve medication adherence. Development of novel strategies to evaluate and detect reasons behind medication non adherence could also be explored.

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