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ORIGINAL ARTICLE

The Challenges of Implementing a Text Message Intervention to Promote Behavioral Change in Primary Care Patients With Hypertension and Diabetes

João Antonio de Queiroz Oliveira,¹ Christiane Cimini,² Vania Almeida,² Junia Xavier Maia,¹ Raissa Eda Resende,¹ Leticia Alves Gualberto,² Pedro Henrique Lauer Santos,² Paulo R. Gomes,¹ Leonardo Bonisson,¹ Maria Cristina Paixão,¹ Janaina Moutinho Costa,¹ Clareci Silva Cardoso,³ Karla Santo,⁴ Antonio Ribeiro,¹ Maria Auxiliadora Martins,¹ Milena S. Marcolino¹

Universidade Federal de Minas Gerais,¹ Belo Horizonte, MG – Brazil

Universidade Federal dos Vales do Jequitinhonha e Mucuri,² Diamantina, MG - Brazil

Universidade Federal de São João del-Rei,³ Divinópolis, MG – Brazil

Hospital Israelita Albert Einstein,⁴ São Paulo, SP – Brazil

Abstract

Background: Controlling blood pressure and glycemic levels is a challenge that requires innovative solutions.

Objective: To assess the feasibility of implementing a text message intervention among low-income primary care patients, as well as to assess self-reported behavioral change.

Methods: A set of 200 text messages was developed on healthy eating, physical activity, adherence, and motivation. Participants from Vale do Mucuri, MG, Brazil diagnosed with diabetes or hypertension or undergoing screening for those diseases, received 5 to 8 messages per week for 6 months. They answered a questionnaire to report their satisfaction and behavioral changes.

Results: Of the 136 patients, 117 (86.0%) answered the questionnaire. Most reported that the messages were very useful (86.3%), easy to understand (90.6%), and were very helpful for behavioral change (65.0%); 84.6% reported that they had started eating healthier. The most frequent reported lifestyle changes were: improved diet quality (85.5%), reduced portions (65.8%), and weight loss (56.4%). The majority of patients shared the messages (60.7%) with family or other acquaintances, considered the number of messages to be adequate (89.7%) and would recommend the program to others (95.7%).

Conclusion: An intervention based on text messages to promote behavioral change in patients with hypertension or diabetes in primary care is feasible in low-resource settings. Future studies are needed to assess the program's long-term effects on clinical outcomes.

Keywords: Arterial Pressure/prevention and control; Hypertension/prevention and control; Blood Glucose/prevention and control; Physical Activity; Lifestyle; Surveys and Questionnaires.

Introduction

The burden of non-communicable diseases such as hypertension and diabetes is growing, especially in developing countries. This is largely attributable to behavioral factors, overconsumption of unhealthy foods and energy dense diets, obesity, social stress, and sedentary lifestyle,¹⁻³ which are a consequence of

urbanization, industrialization, and globalization.^{3,4} Controlling blood pressure and glucose levels in patients with hypertension and diabetes is challenging, especially in resource-constrained regions.²

Strategies are required that empower and encourage behavioral change and promote treatment adherence.^{3,5,6} Mobile phone ownership has spread worldwide, allowing mobile-technology-based

Mailing Address: Milena S. Marcolino

Universidade Federal de Minas Gerais, Department of Internal Medicine. Avenida Professor Alfredo Balena, 190, sala 246. Postal code: 31270-901. Belo Horizonte, MG – Brazil
E-mail: milenamarc@gmail.com

interventions (mHealth) in patient education and chronic condition management.⁷

A recent systematic review assessed the effectiveness of mHealth interventions to promote physical activity and healthy diet in low- and middle-income countries. The results were heterogeneous, and no clear patterns could be determined among interventions that succeeded and those that did not.⁴ Thus, further studies on the topic are warranted and timely.

Since text messaging, an easy strategy based on a widespread and low cost communication system, is considered an appropriate intervention for a variety of health behaviors,⁸ our aim was to assess the feasibility of a text message intervention among primary care patients with hypertension or diabetes in a low-resource setting, evaluating self-reported behavioral change and user satisfaction.

Methods

Study design and setting

This is a substudy of HealthRise Brazil Teofilo Otoni (HRTO) Project. The project is part of a previously described multinational program.^{9,10} The intervention was conducted at 34 primary care centers in 10 municipalities in the Vale do Mucuri region of Minas Gerais, Brazil.⁹⁻¹¹ It was approved by Research Ethics Committee of the Universidade Federal dos Vales do Jequitinhonha e Mucuri (number: CAAE 65808517.9.0000.5108).

Participants

Patients aged 30 to 69 years, with no concomitant diagnosis that would limit life expectancy and no severe cognitive impairment, being neither bedridden nor unable to attend appointments at the primary care unit, were eligible for the HRTO Project. For the present study, participants in HRTO Project were eligible if they agreed to participate and had a mobile phone capable of receiving short text messages. Informed consent was obtained from all participants.

Development of the text messaging intervention and expert panel assessment

A set of text messages was developed in 6 categories: (1) nutritional, (2) physical activity, (3) medication adherence, (4) motivational, (5) smoking, and (6) insulin

administration, capillary blood glucose monitoring, and hypoglycemia. The messages were based on evidence-based guidelines¹²⁻²³ and the Brazilian National Nutritional Guide.²⁴

The messages were designed to provide information, motivation, advice, and positive reinforcement, to promote medication adherence, and to encourage patients to adopt healthy dietary habits, exercise, and quit smoking (where applicable). The messages, which contained up to 145 characters, were reviewed by an expert panel consisting of 1 family physician, 1 cardiologist, 1 endocrinologist, 2 psychologists, 1 nurse, 1 nurse technician, 1 physical therapist, 2 pharmacists, 2 nutritionists, 1 physical education specialist, and 3 patients. Health care professionals were asked to assess the messages' clinical benefits, readability, usefulness, and language, while patients were asked to assess their comprehension and usefulness. All panel members could suggest changes and new messages.

Most of the suggested changes were related to wording, namely to make them more positive, which has been shown to lead to more positive perception of effectiveness than negatively framed messages.²⁵⁻²⁷

The final set included 198 messages. Information on the groups of patients who would receive the specific messages was obtained from the medical record system. The set included both an introductory and a concluding message, which explained that the intervention was over but encouraged the continuance of healthy practices (totaling 200 messages). The messages were semi-personalized. Some examples are shown in Box 1.

Field study

The patients were recruited by primary care professionals. They received text messages 5 to 8 times a week on weekdays for 6 months (February to August, 2018). The messages were always sent at the same time (10:00 AM). Patients with diabetes and/or smokers also received extra text messages, sent at 4:00 PM. These times were based on general Brazilian eating habits, especially those of people in the study region.²⁸

The unidirectional messages, with content predetermined according to the day of the week, were sent free of charge to the patients by an automated program developed and tested by our group.²⁸

Box 1 – Examples of text messages sent to the participants

Introductory message

Hello, [name]! Beginning today, you will receive messages from the HealthRise Project with important information about your health. Read them carefully.

Messages about good nutrition

Hello, [name]! Processed food (such as sodas, canned food, and noodles) have a high sodium content and can lead to hypertension.

Messages about physical activity

Hello, [name]! Have you considered using the stairs instead of the elevator? Climbing the stairs uses more calories! Try it!

Motivational messages

Hello, [name]! Take care of your health, believe in yourself. Go to your scheduled appointments with the doctor or nurse.

Messages containing general information

Hello, [name]! Complications related to high blood pressure may affect the heart, eyes, brain, and kidneys. Talk to your doctor about this.

Final message

Hello, [name]! This message program ends today, but keep up your efforts to maintain healthy habits. They are crucial for your treatment.

The message limit was 145 characters in Brazilian Portuguese.

Satisfaction and behavioral change survey

Based on a previous intervention, a questionnaire was developed about patient satisfaction and self-reported behavioral change.²⁸ It contained 15 questions (14 multiple choice and 1 open-ended).

A Likert scale was used to ask the patients' opinion about the messages' impact on behavior, whether they would like to continue receiving the messages, (if so) with what frequency, and if they would recommend the intervention to a friend or a relative. In a pilot study, the 3 patients had great difficulty understanding differences among the alternatives, so we reduced them to 3 for the sake of clarity.

The survey was applied by telephone. We attempted to call each registered number at least 3 times. When there was no response, a text message was sent describing the topic of the call and the day and time of the next attempt.

Data analysis

We used descriptive methods to assess patient characteristics and survey responses. Continuous variables

were expressed as mean and standard deviation (SD) or median and interquartile range (IQR). The normality of data distribution was assessed using the Kolmogorov–Smirnov test, with a 5% significance level. Categorical variables were expressed as absolute and relative frequencies. All statistical analyses were performed using IBM SPSS Statistics 21 (IBM, Armonk, NY, USA).

Results

Of the 136 patients who received the messages (median age 57 [IQR 51–64] years, 67.6% female) (Table 1), 17 did not read them due to the following reasons: they were illiterate (n = 2), they had no interest in their content (n = 6), they were not the intended recipient (n = 3) because the participant changed telephone numbers during the study without informing the research team or health unit, or for unknown reasons (n = 6). Two other participants refused to answer the survey, leaving a total of 117 (86.0%) survey respondents.

The questionnaire responses are shown in Table 2. The majority of patients considered the messages very useful (86.3%), easily understandable (90.6%), and very helpful for behavioral change (65.0%). Regarding behavior, 84.6% reported a healthier diet, although but most reported no changes regarding exercise (52.1%). The most frequently reported lifestyle changes were improved nutrition quality (85.8%), greater energy for daily activities (69.2%), and reduced portions (65.85). Most respondents reported having shared the messages with friends or relatives (60.7%), considered the volume of messages appropriate (89.7%), and would recommend the program to a friend or a relative (95.7%).

Many patients shared their experiences and suggestions about the intervention (Box S1)

Discussion

This study, developed in a resource-constrained area, found that most participants were pleased to receive text messages promoting healthy lifestyle and self-care regarding hypertension, diabetes, or both. A total of 86%, 91%, and 65% of patients reported that the messages were very useful, easy to understand, and were very helpful for lifestyle change, respectively. The most frequently reported lifestyle changes were improved diet (86%), greater energy for daily activities (69%), and reduced portions (66%).

Our results demonstrate that the text message intervention was feasible and well appreciated by primary care patients in a resource-constrained and mostly rural region, indicating that it could positively impact their hypertension/diabetes care. Saleh et al.,²⁹ assessed the perception of 1000 rural dwellers and refugees in the Middle East diagnosed with hypertension, diabetes, or both, who received text messages to promote lifestyle change. Their results corroborate our findings, ie, the majority of the participants found the messages useful, easy to understand, and that they adhered to the lifestyle change suggestions.

Previous studies in other countries have shown the benefits of text message interventions aimed at behavioral change to help control diabetes. A meta-analysis of 13 clinical trials (1164 diabetes patients) found a 0.62% reduction in A1c levels.³⁰ Glycohemoglobin and blood pressure are surrogates for important clinical outcomes and complications in these patients. In a prospective study on the association between A1c levels, blood pressure, and vascular complications in patients with type 2 diabetes, for each 1% decrease in mean HbA1c, there was a 37% reduction in microvascular complications and a 21% reduction diabetes-related complications, including death.³¹ There was a direct association between blood pressure and complication risk: for each 10 mmHg reduction in systolic blood pressure, there was a 12% decrease in any complications and a 15% decrease in deaths.³²

Other benefits have been increasingly reported for text message programs that promote lifestyle changes, physical activity, smoking reduction or cessation, and medication adherence among patients with chronic non-communicable diseases.^{7,33} In the TELEFIT study, 4 months of educational and motivational text messages promoting weight reduction were sent to 46 patients followed up in primary care. The intervention led to significant reductions in body mass index (BMI) (31.3 kg/m² vs 29.9 kg/m², $p < 0.001$) and systolic and diastolic blood pressure (125 mmHg vs 120 mmHg, $p = 0.013$, and 80 mmHg vs 80 mmHg, $p = 0.006$, respectively).²⁸ A meta-analysis assessing the impact of text messages on smoking found a 1.37 times (95% CI, 1.25-1.51) higher odds of smoking cessation.³⁴ In another meta-analysis, Thakkar et al.,³⁵ found a 2-fold increase in medication adherence among patients with chronic diseases after a text-message intervention (OR 2.11, 95% CI, 1.52-2.93). In a randomized clinical trial, Chow et al.,³⁶ evaluated a 6-month motivational text-message intervention for lifestyle modification in secondary prevention of coronary

Table 1 – Clinical characteristics of the participants (n = 136)

Characteristics	Values
Age, median (IQR), y	57.0 (51.0-64.0)
Female sex, n (%)	92 (67.6)
Diabetes, n (%)	30 (22.1)
Hypertension, n (%)	114 (83.8)
Diabetes and hypertension, n (%)	24 (17.6)
No diabetes or hypertension, n (%)	16 (11.8)
Drinker, n (%)	7 (5.1)
Smoker, n (%)	5 (3.7)
A1c ^b , mean (SD), %	
baseline	8.3 (2.1)
after 6 months	8.4 (2.0)
Blood pressure ^c , median (IQR), mmHg	
SBP at baseline	120.0 (115.0-135.0)
SBP after 6 months	120.0 (120.0-130.0)
DBP at baseline	80.0 (80.0-90.0)
DBP after 6 months	80.0 (80.0-90.0)
BMI ^d , median (IQR), kg/m ²	
baseline	30.3 (26.8-34.7)
after 6 months	30.3 (26.7-34.8)

A1c: glycated hemoglobin; BMI: body mass index; DBP: diastolic blood pressure; IQR: interquartile range; SBP: systolic blood pressure; SD: standard deviation.

^a Extracted from the medical record system.

^b Only patients with diabetes. Number of patients with valid A1c values who did and did not receive the messages at baseline and after 6 months were $n = 7$ and $n = 12$, respectively.

^c Only patients with hypertension. The number of patients with valid SBP and DBP values who did and did not receive the messages at baseline and after 6 months were $n = 37$ and $n = 43$, respectively.

^d The number of patients with valid BMI values who did and did not receive the messages at baseline were $n = 60$, and $n = 77$, respectively, and after 6 months were $n = 42$ and $n = 64$, respectively.

heart disease. They found mean reductions of 5 mg/dL in low-density lipoprotein cholesterol (95% CI, -9-0), 7.6 mmHg in systolic blood pressure (95% CI, -9.8- -5.4), and 1.3 kg/m² in BMI (95% CI, -1.6- -0.9), in addition to a lower risk of smoking (relative risk 0.61, 95% CI 0.48-0.76) and increased physical activity.^{36,37} Results about the impact

Table 2 – Answers to the text message satisfaction survey (n = 117)

Questions assessed and answers	Values n (%)
Message usefulness	
Very useful	101 (86.3)
Somewhat useful	14 (12.0)
Not useful at all	2 (1.7)
Ease of understanding	
Easy	106 (90.6)
Neither easy nor difficult	11 (9.4)
Difficult	0 (0.0)
Lifestyle changes	
Really helpful	76 (65.0)
Somewhat helpful	33 (28.2)
Not helpful at all	8 (6.8)
Messages read per each 10 received	
	10 (8.0-10.0)
Followed the recommendations	
Always	20 (17.1)
Often, but not always	59 (50.4)
Only a few times	30 (25.6)
Never	8 (6.8)
Started eating healthier	
Always	30 (25.6)
Often, but not always	43 (36.8)
A few times	26 (22.2)
No change	18 (15.4)
Began or increased exercise frequency	
Did not exercise before but began to do so	23 (19.7)
Already exercised but increased the frequency	33 (28.2)
No change	61 (52.1)
The messages helped remind me to take my medication	
Always	50 (42.8)
Often, but not always	20 (17.1)
A few times	10 (8.5)
Never	36 (30.8)

Changes reported after receiving the messages

Improved nutrition quality	100 (85.5)
Increased energy	81 (69.2)
Reduced portions	77 (65.8)
Weight loss	66 (56.4)
Increased exercise	55 (47.0)
No change	14 (12.0)
Deleted the messages immediately	
	32 (27.4)
Shared the messages	
	71 (60.7)
Felt the number of messages was	
High	7 (6.0)
Appropriate	105 (89.7)
Low	4 (3.4)
Uncertain	1 (0.9)
Would like to keep receiving the messages	
Yes, daily	51 (43.6)
Yes, 3 to 5 times a week	24 (20.5)
Yes, 1 to 2 times a week	39 (33.3)
No	3 (2.6)
Would recommend the program to a friend or relative (yes)	
	112 (95.7)

of text message interventions on systolic and diastolic blood pressure in hypertensive patients are still inconclusive. Some studies have demonstrated benefits, but their quality of evidence is low.^{38,39}

In 2018 in Brazil, 82.9% of urban dwellers and 57.3% of rural dwellers were mobile phone users.⁴⁰ At the end of 2019, 51.6% of all numbers were on a prepaid basis. This method has more controllable costs, and defaulting on payment has no major consequences,⁴¹ which facilitates cancelling and changing numbers. Thus, it is of the utmost importance to follow the World Health Organization's recommendation to monitor message reception by patients in text message interventions.⁴² In Box 2, we describe the lessons we learned from the intervention.

This study suggests that a lifestyle intervention based on behavioral change principles that delivered self-care advice through a well-accepted information and communication modality (text messaging) effectively promoted lifestyle change in a group of 117 Brazilians adults. Such changes help

control non-communicable diseases, such as hypertension and diabetes. The fact that a relevant proportion of the participants shared the messages with relatives and/or friends is suggestive of the intervention's reach, ie, that behavioral change can spread beyond participants to the people in their environment.

This study included the collaboration of a psychologist with expertise in primary care, ensuring that the messages were not negatively framed. We believe that future studies investigating text messages as a health intervention should focus on positively framed messages. Patients play a fundamental role in their own health care and must be encouraged to participate in decisions about their therapy and to understand their options and the consequences of their actions. An imperative tone can be a barrier to behavioral change.⁴³ Positively framed messages tend to be more acceptable, empowering patients and including them as an important partner in their own care.

Although the results of this study hold promise, including the high rate of engagement and the remarkable lifestyle changes, it is important to recognize some limitations. It is possible that people who might have benefitted from the intervention were excluded due to lacking a mobile phone or being illiterate. Moreover, the intervention's duration was relatively short, and the sample size was small. Future studies are needed to assess its long-term impact. Several factors could be altered or enhanced to further improve clinical outcomes. It is known, for example, that self-monitoring data are subject to reporting bias. Additionally, potential barriers should be taken into consideration when a text messaging protocol is implemented in low resource settings, including inadequate health literacy, which could lead to misinterpretation of message content, vision problems (especially considering that most of our participants were over 60 years old), and language barriers. To overcome these problems, we assessed message comprehension in primary care patients prior to implementing the intervention. Other barriers to such interventions include privacy and disclosure issues, as well as logistical issues, such as a lack of network coverage or the inability to charge a phone due to lack of electricity, although the latter has been decreasing with expanding national infrastructure.

Although telehealth solutions for patients with chronic diseases are becoming a trend, such initiatives are generally isolated efforts and are not integrated with other information and communication technology solutions, such as electronic health records. Our service (Telehealth Center of the Universidade Federal de Minas Gerais University Hospital) is currently involved in a joint program with the Brazilian

Box 2 – Lessons learned

Development and planning

The importance of multi-professional involvement and collaborative work in message development, especially evaluation by an expert panel that also includes people with the same profile as the participants

Implementation

Monitor the sending and receiving of messages by contacting participants, rather than merely relying on the automatic feedback system, which can identify problems such as:

- phone number changes
- lack of connectivity or network instability
- non-receipt for no apparent reason

Make sure that participants have the minimum literacy to understand the messages or someone who can read/explain them

Feedback

Contact participants to assess the appropriateness of message frequency and content during the program as a way of personalizing the service without losing quality

Ministry of Health in an attempt to resolve this problem, integrating text message delivery with the medical record system. Policy makers must support the development and implementation of mHealth interventions, considering that such an investment will lead to better care for those suffering from chronic diseases, thus strengthening health services. The importance of investing in e-health and telehealth interventions has become more evident since the COVID-19 pandemic, forcing us to reassess the conduct of social organizations and health practices.⁴⁴

Conclusion

Our study showed that a text-based intervention to promote behavioral change in patients with hypertension or diabetes is feasible in resource-scarce settings, reinforcing what appears to be a current trend in health care. The participants were pleased to receive text messages and were willing to continue receiving them. In light of the growing rates of non-communicable diseases worldwide, future studies should assess the limits, reach, and long-term effectiveness of motivational and health educational text messages on clinical outcomes.

Author contributions

Conception and design of the research: Oliveira JAQ, Cimini C, Almeida V, Xavier J, Cardoso C, Santo

K, Ribeiro A, Martins MA, Marcolino M; acquisition of data: Oliveira JAQ, Cimini C, Almeida V, Xavier J, Resende R, Gualberto L, Santos P, Gomes P, Bonisson L, Marcolino M; analysis and interpretation of the data: Oliveira JAQ, Cimini C, Almeida V, Xavier J, Ribeiro A, Martins MA, Marcolino M; statistical analysis: Oliveira JAQ; obtaining financing: da Paixão MC, Ribeiro A, Marcolino M; writing of the manuscript: Oliveira JAQ, Resende R, Martins MA, Marcolino M; critical revision of the manuscript for intellectual content: Oliveira JAQ, Cimini C, Almeida V, Xavier J, Resende R, Gualberto L, Santos P, Gomes P, Bonisson L, da Paixão MC, Costa J, Cardoso C, Santo K, Ribeiro A, Martins MA, Marcolino M.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Study Association

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Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Comitê de Ética em Pesquisa – Plataforma Brasil under the protocol number CAAE nº 65808517.9.0000.5108 and nº 40479820.2.0000.5108. All the procedures in this study were in accordance with the 1975 Helsinki Declaration, updated in 2013. Informed consent was obtained from all participants included in the study.

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