Text messaging interventions to support smoking cessation among hospitalized patients in Brazil: a randomized comparative effectiveness clinical trial

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Abstract

Objective: A clinical trial carried out in patients hospitalized for clinical and surgical conditions. This study evaluated the effectiveness of text messaging interventions (TM) versus telephone counseling (TC) to promote smoking cessation among hospitalized smokers in a middle-income country. Seven-day abstinence was measured during follow-up phone calls one month after discharge. The comparative cost of the two interventions considered the cost of calls, time spent on phone calls and sending SMS and cost of the professional involved in the approaches.

Results: Past 7-day tobacco abstinence was not statistically different between groups (30.5% in TM group and 26% in TC, p = 0.318). Costs were significantly lower in the TM group (US$9.28 × US$19.45 - p < 0.001). Continuous abstinence was reported by 26% of TM participants and 24.5% of TC participants (p = 0.730). In the 3-month follow-up, 7-day abstinence was 23% in the TMI and 27% in the TC (p = 0.356) group. Continuous abstinence was reported by 20% of TM participants and 24% of TC participants (p = 0.334).

Trial registration: ClinicalTrials.gov ID: NCT03237949 Registered on: 30th May 2017.

Keywords: Patient discharge, Randomized trial, Smoking cessation, Text messaging

Introduction

Smoking is the leading cause of premature death worldwide [1, 2]. During hospital stays, when they were hospitalized for diagnosis and treatment of clinical and surgical conditions, patients must abstain from smoking, and they are particularly accessible and interested in receiving advice to quit [3–7]. Increased access to phones, cell phones, the internet, and the emergence of quitlines have made these strategies attractive vehicles for novel health interventions [8–15].

Brazil has one of the world’s most successful tobacco control programs, leading to a significant reduction in the prevalence of smoking in the last three decades (from more than 40% to less than 10% of the population). Brazil implemented numerous tobacco control policies including smoke-free air laws, marketing restrictions, graphic health warnings on cigarette packaging, national smoking cessation campaigns through the mass media, cigarette price increases and a national smoking cessation treatment program [16–19]. However, only a few hospitals in
Brazil actually have a protocol to address smoking cessation with their patients [20–23].

Text messaging shows strong potential to extend care to hospitalized smokers in Brazil during the post-discharge period [3]. Text message interventions are effective for smoking cessation [24–26] and have a wide reach and low cost [24]. Most Brazilians- 86% of the population aged 10 years or over- are mobile phone users [27].

The present study is the first definitive randomized clinical trial to evaluate SMS for the post-discharge follow-up of smokers in Brazil. However, most smokers do not receive smoking cessation treatment when trying to quit [3]. Different from other countries, there is limited research investigating SMS to support smoking cessation among post-discharge patients in Brazil.

The objective of the present study was to evaluate the effectiveness and costs of a post-discharge text messaging (TM) versus telephone counseling (TC), for supporting cessation among hospitalized smokers in Brazil.

**Main text**

**Methods**

**Design**

The design a 1:1 ratio two-arm randomized controlled clinical trial of non-inferiority conducted with hospitalized smokers. The study was approved by the Hospital Ethics Committee Review Board/process number 2.868.112. The trial is registered in the Clinical Trials Registry (NCT03237949) and the Brazilian Clinical Trials Registry (RBR-8mgc3h). The study adheres to the CONSORT Guidelines.

**Setting and participants**

This study was conducted at a university hospital located in the city of Juiz de Fora in the southeastern part of Brazil. Smoking is prohibited in the hospital (tobacco-free campus) and patients had to remain abstinent throughout their stay. Patients were recruited from all units of a 159-bed public university hospital. Participants were involved in an initial pre-screening process using the Electronic Medical Record System (EMR) and then answered an initial pre-screening survey administered by the researcher manually by a cell phone. Messaging was unidirectional messages per day for 15 days. Text messages were sent to the content of text messages was used [29]. The study adheres to Bandura's self-efficacy theory to design the content of text messages was used [29]. The study did not assess abstinence in the last 15 days but we used the intention to quit (or remain abstinent) in the next 30 days, collected in the baseline assessment, to customize the text message content. Participants abstinent or preparing to quit in the next 30 days received two messages per day for 15 days. Text messages were sent manually by a cell phone. Messaging was unidirectional participants were unable to reply to messages.

**Telephone counseling**

In TC, participants received one weekly phone call for 4 weeks. Four attempts were made, on different days and times of the day, per week for each participant. Telephone counseling lasted approximately 15 to 30 min. The counseling approach addressed motivation, confidence, quitting history, environmental factors, trigger situations, coping strategies, medication use, relapse prevention and setting a quit date. This is the standard treatment.
given to all discharged patients, except in the intervention group (TM) during this study. The approaches were based on concepts of motivational interviewing and cognitive behavioral therapy. Each telephone counseling was designed to help patients develop an individualized plan to quit smoking or to remain abstinent. The approach was based on Motivational Interviewing (quote) and addressed behavioral and cognitive issues, including motivation, confidence, quitting history, environmental factors, trigger situations, coping strategies, medication use, relapse prevention and setting a quit date [30].

These approaches were based on previous pragmatic tobacco treatment research [3].

**Measures**

Measures included demographics and social class distribution [30]. The nicotine dependence was evaluated via Fagerström Test [32]. Withdrawal symptoms during hospitalization [33], tobacco use characteristics, readiness to quit [34], and nicotine replacement therapy during hospitalization were assessed. The Patient Health Questionnaire –4 (PHQ-4) and the Alcohol Use Disorder Identification Test (AUDIT-C) were used [35, 36].

The main outcome measure was self-reported 7-day point prevalence abstinence at 1 month post-randomization (“Did you smoke even a single puff in the last 7 days?”). Secondary outcomes included self-reported 30 days continued abstinence at 1-month post-randomization (“Did you smoke even a single puff in the last 30 days”), and biochemically verified abstinence at 3 months post-discharge. Exhaled carbon monoxide of ≤10 ppm was the cutoff for verification of abstinence [37].

To calculate costs, we analyzed the average time spent on interventions, the minute value of each intervention per participant, the amount paid to the telephone company, and the cost per minute worked by the healthcare professional, based on the federal employees’ salary scale. Costs were calculated in Brazilian Real and converted into dollars on January 7, 2020 (1 dollar = 4.08 Brazilian Real).

**Analyses**

Research Electronic Data Capture (REDCap) was used to enter the data. After descriptive statistics, the comparison of categorical variables was performed by chi-square and, for continuous variables with normal distribution, t-tests for independent samples. Nonparametric distribution variables were analyzed by Mann–Whitney. Subjects lost to follow-up were counted as smokers (intention to treat analysis—ITT).

A comparative assessment of intervention costs was performed using cost minimization, used to measure the cost difference between alternative interventions, when it is assumed that both have the same effectiveness [38].

**Results**

Participants were recruited from May 2017 to January 2019. Of 629 individuals identified as smokers, after evaluating exclusion criteria, 400 participants were randomized and allocated to the study groups. Some interruptions occurred due to the worsening of the medical condition of the patients or for the performance of complementary exams at the time of the approach (Figure S1).

**Participant characteristics**

Randomization led to similar groups for all baseline characteristics, except for the age of tobacco initiation (Table 1).

The proportion of participants reached for follow-up was 73.25% (n = 293) at 30 days post-discharge and 66% (n = 264) at 90 days post-discharge.

**Abstinence at 1 and 3 months after discharge**

Self-reported, 7-day point prevalence abstinence rates were not statistically different between groups at 1 month post-discharge using an ITT analysis (p = 0.318). Similarly, 30 day continuous abstinence was not significantly different between groups (p = 0.730), however the number of cigarettes per day smoked was fewer in the TM group (p < 0.036). Quit rates were also not significantly different at 3-month follow-up (Table 2).

**Cost analysis**

Costs were significantly lower in the TM group compared to the TC group. Cost results can be seen in Table 3.

**Discussion**

This was the first fully-powered study to compare the effectiveness of text messaging versus telephone counseling for post-discharge smoking cessation treatment. Both led to a high prevalence of self-reported smoking abstinence. Cost analysis found that text messaging intervention was half as expensive as phone calls.

A recent meta-analysis included 26 clinical trials and concluded that there is moderate evidence that text messages increase cessation rates by approximately 50% when compared to support for smoking cessation [26].

In the last decades, there has been a great advance in the use of communication technologies in health care. This phenomenon contributed to the emergence of innovative health behavior change interventions [24] and several strategies have been studied to help hospitalized smokers to quit [11, 12, 15].
Table 1  Baseline characteristics of study participants by treatment group

| Variables                                      | Standard care (control) | Sustained care (intervention) | p     |
|------------------------------------------------|-------------------------|-------------------------------|-------|
|                                                | M (SD)                  | M (SD)                        |       |
| Age (years)                                    | 45.97 (12.58)           | 45.45 (12.92)                 | 0.701 |
| Age at smoking initiation                      | 18.70 (16.35)           | 16.09 (7.40)                  | 0.001 |
| Importance of quitting (0–10)                  | 10 (0)                  | 10 (0)                        | 0.844 |
| Confidence to quit (0–10)                      | 7 (5)                   | 8 (5)                         | 0.273 |
| Withdrawal scale (0–4)                         | 3 (4)                   | 3 (4)                         | 0.303 |
| Male                                           | 102 (51.3)              | 94 (47.2)                     | 0.422 |
| Ethnoracial group (self-declared)              |                         |                               | 0.511 |
| White                                          | 67 (36.2)               | 62 (33.0)                     |       |
| Black, grayish-brown/indigenous                | 118 (63.8)              | 126 (67.0)                    |       |
| Education level                                |                         |                               | 0.201 |
| 0–4 years                                      | 5 (2.6)                 | 1 (0.5)                       |       |
| 5–8 years                                      | 78 (40.4)               | 75 (38.1)                     |       |
| More than 9 years                              | 110 (57)                | 121 (61.4)                    |       |
| Married or with a partner                      | 61 (33)                 | 58 (32.2)                     | 0.878 |
| SES$^1$—average household income in dollars/month$^2$ | | | 0.228 |
| SES A (USD 5.058)                              | 1 (0.5)                 | 0.0 (0.0)                     |       |
| SES B1 (USD 2.241)                             | 2 (1.0)                 | 1.0 (0.5)                     |       |
| SES B2 (USD 1.175)                             | 43 (21.1)               | 30 (15.0)                     |       |
| SES C1 (USD 655)                               | 112 (56.3)              | 110 (55.0)                    |       |
| SES C2 (USD 393)                               | 42 (21.1)               | 58 (29.0)                     |       |
| SES D+E (USD 186)                              | 6 (0.0)                 | 1.0 (0.5)                     |       |
| Cigarettes/day                                  |                         |                               | 0.165 |
| < 10                                           | 81 (40.5)               | 94 (47.3)                     |       |
| 11–20                                          | 72 (36.0)               | 83 (41.7)                     |       |
| > 21                                           | 47 (23.5)               | 22 (11.0)                     |       |
| Time to first cigarette of the day             |                         |                               | 0.264 |
| After 60 min                                   | 34 (17.3)               | 52 (26.4)                     |       |
| Between 31 and 60 min                          | 24 (12.2)               | 19 (9.6)                      |       |
| Between 6 and 30 min                           | 61 (31.0)               | 43 (21.8)                     |       |
| The first 5 min                                | 78 (39.5)               | 83 (42.2)                     |       |
| Nicotine dependence$^3$ ≥ 5                    | 168 (84.0)              | 179 (89.5)                    | 0.105 |
| Quit attempts in past year                     | 69 (34.5)               | 87 (43.5)                     | 0.065 |
| Life use quit medication                       |                         |                               | 0.742 |
| NRT                                            | 32 (16.1)               | 34 (16.9)                     |       |
| Bupropion                                      | 15 (4.6)                | 15 (7.5)                      |       |
| Champix or Varenicline                         | 2 (1.0)                 | 0 (0.0)                       |       |
| Commitment to quitting                         |                         |                               | 0.711 |
| Plan to stay quit                              | 118 (62.8)              | 125 (64.4)                    |       |
| Plan to try to stay quit                       | 25 (13.3)               | 27 (13.9)                     |       |
| Plan to reduce smoking                         | 34 (18.1)               | 28 (14.4)                     |       |
| Plan not to quit                               | 11 (5.9)                | 14 (7.2)                      |       |
| Current depressive symptoms$^4$                 | 88 (56.1)               | 88 (55.3)                     | 0.900 |
| Current anxiety symptoms$^5$                    | 96 (72.2)               | 98 (76.6)                     | 0.418 |
| Mild to Severe Risk of alcohol abuse$^6$       | 133 (66.5)              | 123 (61.5)                    | 0.298 |
| NRT during hospitalization                     | 188 (94.0)              | 190 (95.0)                    | 0.661 |
| Any smoking-cessation treatment                | 23 (13.9)               | 26 (20.5)                     | 0.133 |
Table 1 (continued)

| Variables                                      | Standard care (control) | Sustained care (intervention) | p     |
|------------------------------------------------|-------------------------|-------------------------------|-------|
| Any smoking-cessation counseling              | 57 (34.8)               | 37 (29.6)                     | 0.354 |
| Interest in receiving medication              | 170 (89.9)              | 171 (91.9)                    | 0.503 |

M Mean, SD Standard deviation, Md Median, IR Interquartile range, SES Social economic stratum, NRT Nicotine replacement therapy

1 Assessed via Brazilian criteria and social class distribution (ABEP 2016)
2 1 real = 4.129 dollars, december 09, 2019
3 Assessed via Fagerström test for nicotine dependence
4,5 Assessed via patient health questionnaire 4 item (PHQ-4)
6 Assessed via alcohol use disorder identification test (AUDIT-C)

Table 2 Abstinence at follow up post-discharge by treatment group

| Variables                                      | Sustained care (Intervention) N (%) | Standard care (Control) N (%) | p     |
|------------------------------------------------|-------------------------------------|-------------------------------|-------|
| Follow-up 30 (missing = smoking)              |                                     |                               |       |
| Abstinences for the past 7 days               | 61 (30.5)                           | 52 (26.0)                     | 0.318 |
| Abstinences for the past 30 days              | 52 (26.0)                           | 49 (24.5)                     | 0.730 |
| Follow-up 90 (missing = smoking)              |                                     |                               |       |
| Abstinences for the past 7 days               | 46 (23.0)                           | 54 (27.0)                     | 0.356 |
| Abstinences for the past 90 days              | 40 (20.0)                           | 48 (24.0)                     | 0.334 |
| Abstinences verified by measurement of exhaled carbon monoxide 2 | 20 (95.2) n = 21 | 8 (80.0) n = 10 | 0.160 |
| Number of cigarettes per day in non-abstinent participants at follow-up 30 | 9.99 (15.033) | 13.91 (14.859) | 0.036 |
| Number of cigarettes per day in non-abstinent participants at follow-up 90 | 10.04 (14.997) | 12.51 (12.421) | 0.131 |

M Mean, SD Standard deviation

1 Subjects lost to follow-up were counted as smokers (intention to treat analysis—ITT)
2 Participants were characterized as abstinent if their results were ≤ 10 ppm

Table 3 Cost analysis by strategies of counseling post-discharge

| Analysis                                      | Text messages interventions | Telephone calls | p     |
|------------------------------------------------|-----------------------------|-----------------|-------|
| Quantity per patient                          | 14 a 30                     | 4               |       |
| Monthly cost of telephone company             | R$ 22.50                    | R$ 69.90        |       |
| Average time                                  | 1 message- 0.5 min          | 1 call- 4.7 min |       |
| Average number of retries per approach        | 1                           | 3.15            |       |
| Time spent on unsuccessful attempts per patient | 0 min                      | 8 min           |       |
| Health worker’s minute value 1                | R$ 0.77                     | R$ 0.77         |       |
| Total cost per patient                        | R$ 5.39 / R$ 11.55          | R$ 20.63        |       |
| Cost total per group (200 participants)       | R$ 2.310.00                 | R$ 4.126.00     |       |
| Cost per abstinent participant in last 7 days with 30 days of follow-up | R$ 37.87 | R$ 79.34 |       |

1 According to Table of Salaries of Civil Federal Civil Servants of Jan 2019 –Education Technicians Category E (undergraduate level)
2 Referring to 15 messages for the least motivated group and 30 messages for the group motivated for cessation
3 Sum of call times completed, and average spent on unsuccessful attempts per patient

p < 0.001
Behavior change interventions sent by text messages are becoming increasingly popular, the possibility of reaching many people when performing interventions without personal contact reduces costs and allows access to people who are reluctant to have direct contact [24, 25, 39, 40].

Text messages have been used in Brazil for approximately 30 years, but the strategy, despite offering great advantages in the health area, is still little explored for this purpose. Despite the Brazilian tobacco control program reaching a significant number of people, through actions of the Unified Health System (SUS), the country’s free public health system, communication technologies such as SMS are still not used by the program. Text messaging strategies are promising especially for low/middle-income countries where proactive telephone counseling is not available for free and quitline services are not structured. Future studies should address the effectiveness of automated messaging systems, evaluate ways to promote better interactivity with the participants, and determine the intensity of the approach to deliver the best results.

Limitations
Loss of follow up is an important limitation of longitudinal studies. In this study, there were significantly fewer reached for follow up in the standard care (TC) group than in the TM group. Other limitations are the loss of interactivity due to the lack of actions aimed at possible participants’ responses to messages (unidirectional messaging) and the unavailability of an automated messaging system.

Abbreviations
TM: Text messaging; TC: Telephone counseling; CPIT: Interdisciplinary center for research and intervention in tobacco; CDC: Center disease control; PHQ-4: Patient health questionnaire-4; AUDIT-C: Alcohol use disorder identification test; REDCap: Research electronic data capture; ITT: Intention to treat analysis; M: Mean; SD: Standard deviation; Md: Median; IR: Interquartile range; SES: Social economic stratum; NRT: Nicotine replacement therapy; ppm: Particles per million.

Supplementary Information
The online version contains supplementary material available at https://doi.org/10.1186/s13104-022-06002-6.

Additional file 1: Figure S1. Participant flow diagram.

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Authors’ contributions
LMA: conceptualization, data curation, formal analysis, investigation, methodology, software, validation, writing-review & editing. TMK: conceptualization, methodology, writing-review & editing. ROA: conceptualization, data curation, formal analysis, investigation, methodology, project administration, supervision, software, validation, writing-review & editing. All authors read and approved the final manuscript.

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Availability of data and materials
The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Declarations
Ethics approval and consent to participate
The study was approved by the Hospital Ethics Committee Review Board/ process number 2.868.112 and all participants signed informed consent. Participants were not reimbursed for participation, as this is not permitted under Brazilian law. The trial is registered in the Clinical Trials Registry (NCT03237949) and the Brazilian Clinical Trials Registry (RBR-8mgc3h).

Consent for publication
Not applicable.

Competing interests
The authors declared no competing interest in the subject matter or materials discussed in this article.

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