

The Pennsylvania State University

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**TXT2STAYQUIT: A PILOT RANDOMIZED TRIAL OF BRIEF AUTOMATED
SMOKING CESSATION TEXTING INTERVENTION FOR INPATIENT SMOKERS
DISCHARGED FROM THE HOSPITAL**

A Thesis in

Public Health Sciences

by

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ABSTRACT

Introduction: Inpatient hospitalization requires smokers to quit temporarily and offers an opportunity for health care professionals to provide smoking cessation treatment. Text messaging may provide a method for continuing smoking cessation support and monitoring smoking status post-discharge.

Methods: This is a randomized controlled trial of automated smoking cessation support on discharge as an adjunct to brief advice among hospital inpatients. Participants were inpatients who self-identified as tobacco users at the time of admission. Those who accepted cessation counseling as part of usual care were screened for study inclusion. Eligible participants smoked ≥ 20 cigarettes in the 30 days prior to admission, were willing to give up all forms of tobacco, had a cell phone with them capable of receiving text messages, and were willing to send/receive text messages. Participants were randomized to receive weekly smoking status questions (control) or weekly smoking status questions plus daily smoking cessation tips (intervention). Text messages began the day the participant was discharged from the hospital and continued until phone call follow-up at one month post-discharge. Quit status was based on self-report seven-day point prevalence abstinence.

Results: 140 participants, 70 receiving the intervention and 70 controls, were included in this analysis. Participants were 60% female, 81% white, an average of 42 years old, smoked an average of 14 cigarettes per day, and had an average hospital stay of 5 days with no significant differences between the intervention and control group. Intent-to-treat analysis found that 37% (n=26) of control participants and 44% (n=31) of intervention participants had quit at 1 month post-discharge (p=0.39). Overall, 56% (n=78) of participants responded to at least 4 of the 5 smoking status questions. Of those who completed the subjective ratings of the text messaging program at phone call follow-up (n=114), 75% (n=46) of intervention participants rated the text

messages as 'good' or 'excellent' and an additional 13 rated as 'satisfactory' compared with 58% (n=31) of control participants rating the helpfulness of the text messages 'good' or 'excellent' with another 13 rating them as 'satisfactory' ($p=0.01$).

Conclusion: Automated smoking cessation text messaging may provide a feasible and well-received method to encourage inpatient smokers to stay quit as well as to monitor their smoking status post-discharge from hospital.

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Chapter 1

Introduction

As the leading cause of preventable death, smoking is responsible for over 480,000 deaths per year in the United States [1]. Although smoking rates have declined over the past decade, as of 2014, 16.8% of U.S. adults were cigarette smokers [1]. While 69% of current smokers in 2010 reported wanting to quit, overall prevalence of cessation for ≥ 6 months in the past year was only 6% [2]. There are many evidence-based methods available to help smokers to quit, including counseling and medications, which when combined can at least triple the odds of success in a quit attempt [3, 4]. Although these resources are available, in 2010, only 31% of those who made a quit attempt or had recently quit utilized any assistance in doing so [2]. The “Treating Tobacco Use and Dependence Clinical Practice Guideline: 2008 Update” calls for a need for new strategies in tobacco treatment, particularly in certain populations such as hospitalized smokers [4].

Hospitalization provides a unique opportunity in which health care providers can deliver smoking cessation support. It is often particularly important for hospitalized smokers to quit in order to optimize recovery outcomes, particularly those related to cardiac health and bone and wound healing [4]. In addition, inpatient smokers may be motivated to quit if they perceive their hospitalization as due to a tobacco related condition [5]. Hospitalization may also provide an opportune time to make a quit attempt as hospitals are now required to be smoke-free in order to meet Joint Commission accreditation standards and many have extended this to include the entire hospital campus [4]. Thus, inpatient smokers will be required to remain abstinent for the duration of their hospitalization, and during this time will also have access to health care providers that can

provide smoking cessation treatment [5]. However, it is also important that cessation encouragement continue after the patient has been discharged from the hospital.

Text messaging may provide a potential new strategy for delivering post-discharge smoking cessation support. As of 2014, 90% of Americans own a cell phone and 81% of these people utilize text messaging [6]. As a result, this may be a convenient and low-cost way to provide support to smokers during a quit attempt. Although interventions for hospitalized smokers have been found to be effective, these studies utilized techniques including counseling, self-help materials, and phone call or in-person follow-ups rather than text messaging as a means for delivering the intervention [7]. However, text messaging may provide a more cost-effective approach to reaching patients after they have been discharged from the hospital. Research has shown that text messaging interventions for smoking cessation are efficacious in increasing biochemically-confirmed cessation rates at six month follow-up, achieving quit rates of about 11% in the intervention group and 5% in the control group [8, 9]. This method of smoking cessation support was found to be feasible in certain vulnerable populations such as pregnant women, although more research is needed regarding effectiveness in this population [10]. Another population that may benefit from this type of smoking cessation support is smokers who have recently been discharged from the hospital.

While studies have begun to investigate the efficacy of delivering smoking cessation support via text messaging, few have applied this to smokers recently discharged from the hospital. Not only may this benefit the patient, but may also provide a feasible method for hospitals to meet Joint Commission standards in the area of Tobacco Treatment. The Tobacco Treatment measurement standard is one of an optional set of fourteen performance measures, of which accredited hospitals must choose four to report. The measure set encompasses tobacco use screening at admission, treatment during hospitalization and at discharge, and assessing smoking status post-discharge [11]. Text messaging may provide an option for following up on

smoking status after patients are discharged from the hospital. This study aimed to assess whether a text message smoking cessation intervention is effective in increasing the proportion of inpatient smokers who remain abstinent one month after receiving brief counseling as an inpatient and being discharged from the hospital. It also evaluated the feasibility of assessing smoking via text messages throughout the first month post discharge.

Chapter 2

Methods

This randomized controlled trial recruited and enrolled inpatient smokers at Hershey Medical Center in Hershey, PA between December 2013 and March 2015. At the time of admission, patient tobacco use status was assessed by nursing staff. A consult request was then sent to the Respiratory Care department for those who self-identified as tobacco users. A trained smoking cessation counselor (a respiratory therapist or member of the research team) visited the patient bedside and offered smoking cessation counseling to tobacco users, as part of usual care. Bedside counseling included reviewing the contents of two brochures provided to the patient. The first informed the patient as to how their body's function improves as they quit smoking. The second included information about creating a plan for quitting smoking, cessation medication options, calculations of the time and money saved by quitting, as well as additional resources such as the national quitline, 1-800-QUIT-NOW. Those who accepted counseling were further screened for inclusion in the study. Participants were eligible for the study if they had an inpatient stay of at least twenty-four hours, were free of any cognitive impairment, were able to read and speak in English, were not admitted for a transplant, did not have intensive care status, had smoked at least twenty cigarettes in the thirty days prior to admission, were willing to give up all forms of tobacco, and had a cell phone with them, charged, and able to receive text messages. Eligible participants were offered enrollment in the study, provided informed consent, and completed a baseline questionnaire which included demographics, information about cell phone use (i.e. how often they sent texts), cigarette dependence, and details regarding smoking habits and smoking history. Participants consented to allow the researchers to extract basic information

from the Electronic Medical Record (EMR) which included admission date, reason for admission, and length of hospital stay. A \$20 gift card was provided to participants upon completion of enrollment.

Randomization and Text Messaging System

The study statistician, Dr. Arthur Berg, used R software to generate an equally balanced randomization code following a simple randomization procedure. All potential participants who were screened for eligibility received a randomization ID number. For those who were eligible, the randomization ID number along with the participant's cell phone number were entered in to the text messaging system maintained by Dr. Erika Poole and her team in the College of Information Sciences and Technology at Penn State. The system registered the phone number to the appropriate arm of the study corresponding to the randomization ID number and the researchers remained blind to the condition assigned. Welcome texts were sent to the participant immediately so that the researcher could verify that the system was communicating with the participant's phone. The welcome texts included a practice question about whether the participant had smoked since they were admitted to the hospital, which allowed the researcher to show the participant how to respond to future outcome questions. Participants were instructed to text "LEAVE" when they were discharged from the hospital in order to start the text message intervention and received a daily text message reminder to do so until the system was activated. Researchers consulted a report of participant discharge dates and for those participants who did not activate the system within twenty-four hours of discharge, the researchers did so manually. The control group received five outcome questions inquiring about smoking status and smoking cessation medication use throughout the month after discharge. In addition to the outcome questions, the intervention group received smoking cessation tips on a decreasing message schedule (five per day for the first two weeks, three per day in the third week, and two per day in the fourth week) developed with the input of smoking cessation professionals. Sample text

messages can be found in Figure 1. The intervention texts included motivational messages and behavior change suggestions, as well as emphasizing the benefits of quitting smoking.

Participants in the intervention group also had the option to text the word MOOD, CRAVE, or SLIP to the system to receive extra support at times when they were feeling stressed, had a craving, or had a slip

Figure 1: Examples of Study Text Messages

Sample Text Messages	
Welcome Texts	“Welcome to TXT2STAYQUIT! And thanks for being in this study. Congrats on your decision to stay off tobacco. It will help us if you can text LEAVE by replying to this number as soon as you leave the hospital. To opt out at any time, text STOP to this number.”
Intervention Messages	<p>“You will find it much easier to stay quit if you carefully get rid of all your cigarettes, matches, and lighters”</p> <p>“Think of quitting smoking as a process, not an event. It is something you can succeed with, taking one day at a time, and sticking with it”</p> <p>“1-800-QUITNOW (1-800-784-8669) is the free national quitline number. They can provide free telephone advice on quitting smoking”</p> <p>“Ask your family, friends, and coworkers for their support. Ask them not to smoke around you or leave cigarettes lying around”</p> <p>“Are you rewarding yourself for staying smoke free? Use a non-food reward such as going to the movies, dancing, or on a vacation”</p> <p>“Anticipate high risk situations where you might be tempted to smoke. Make a plan to handle them without smoking.”</p>
Keyword “CRAVE” Messages	<p>“Even the strongest cravings will go away after a few minutes. Focus on something else and remind yourself why you are smoke free”</p> <p>“Cravings will get weaker and less frequent with every day you don’t smoke. Take a breath and get your mind onto something else and it will pass more quickly”</p> <p>“Change your routines as much as possible so that the times when you would usually smoke are not so obvious”</p>
Keyword “MOOD” Messages	<p>“Feelings of irritability and frustration will pass soon. Take a deep breath and get your mind busy with something else”</p> <p>“Smoking actually causes more stress than it relieves. Studies show that stress levels go down after quitting”</p> <p>“Remember that smoking will not solve any problem. It will only create new ones. Tell yourself smoking is not an option to deal with this problem”</p>
Keyword “SLIP” Messages	<p>“Find the trigger. Exactly what was it that made you smoke? Be aware of that trigger. Decide now how you will cope with it when it comes up again”</p> <p>“You’ve had a small setback. This doesn’t make you a smoker again. It’s important to get back on the non-smoking track right away”</p> <p>“Learn from it and focus on all the other times you didn’t smoke. You can still do it”</p>
Outcome Questions	<p>Week 1: “Have you smoked or used any tobacco since you left the hospital?”</p> <p>Week 2: “Have you smoked or used any tobacco in the past week?”</p> <p>Week 2: “Have you used any smoking cessation medicine since you left the hospital?”</p> <p>Week 3: “How many cigarettes have you smoked in the past week?”</p> <p>Week 4: “Have you smoked or used any tobacco in the past week?”</p>

One Month Follow-up

All participants were contacted via phone call to obtain outcome data at one month post-discharge. Participants were asked about current smoking status using seven –day point prevalence abstinence, smoking cessation medications used since discharge, withdrawal symptoms, and perceptions of the text messaging intervention including rating the helpfulness of the text messages received, aspects they found most helpful, and ways they thought it could be improved. For participants who reported smoking in the past seven days, questions were asked regarding how soon they smoked after discharge and their reasons for relapse. Two open ended questions were asked of all participants, “What aspects of the text messaging program did you find most helpful?” and “In what ways do you think the text messaging program could be more helpful?” A \$20 gift card was mailed to participants who completed the phone call follow-up. Biochemical verification of quit status via CO < 10 ppm was offered to a subset of participants who self-reported abstinence at the one-month follow up phone call and lived within thirty miles of Hershey Medical Center. In order to obtain the CO reading, researchers either met participants at upcoming appointments at the medical center or at a location convenient for the participant. An additional \$20 gift card was provided for completion of biochemical verification.

Data Analysis, Sample Size, and Power

Data were analyzed using SAS Software Version 9.4 (Cary, NC). Chi-square and two-tailed t-test were used to determine differences between categorical and continuous variables of interest, respectively. A stepwise logistic regression model with entry and exit criteria set at alpha =.10 was run including all baseline variables found in Table 1 to determine predictors of abstinence at one-month follow-up. A final model was then run to include the randomization variable and any covariates from the first model that had a p-value ≤ 0.05 . This study utilized intent-to-treat analysis and those who did not complete the one-month follow-up phone call were classified as smokers. The study had 63% power with a sample size of 70 per randomization

group to detect a difference in 28-day abstinence (measured using past 7 day point abstinence) of 28.7% in the intervention group compared to 12.1% in the control group. This is the magnitude of change found in the largest published randomized controlled trial of text messages for smoking cessation that reported results using a similar 28-day definition, based on a two-tailed test [9].

Chapter 3

Results

655 inpatient smokers accepted cessation counseling and were assessed for study eligibility; of those assessed, 248 were eligible. 90 potential participants did not consent to the study, leaving 158 participants who were eligible and consented to the study. Of the 158 consented participants, 18 were excluded leaving 140 participants who were included in this analysis, 70 per intervention arm. Further details regarding eligibility can be found in the CONSORT diagram in Figure 2.

Baseline characteristics of the participants can be found in Table 1. Overall, the sample was 60% female, 81% white, and had a mean age of 42 years. Participants smoked an average of 14 cigarettes per day and had a mean Penn State Cigarette Dependence Index score of 11, indicating a medium level of dependence [12]. 89% of participants reported sending text messages most or every day. Participants were admitted to the hospital for various reasons with the most common being conditions related to the musculoskeletal system (n=40), respiratory or circulatory system (n=27), digestive system (n=15), and nervous system (n=13). While 27% (n=38) of participants indicated currently using a smoking cessation medication (at time of consent), EMR data indicated cessation medication use by 39% (n=54) of participants during their hospital stay. Of those who used a smoking cessation medication during their stay, 46 (85%) used the nicotine patch, 3 (6%) Chantix or Wellbutrin, 1 (2%) nicotine inhaler, and 4 (7%) multiple medications. There were no significant differences in baseline characteristics between the intervention and control groups.

Figure 2: CONSORT Diagram

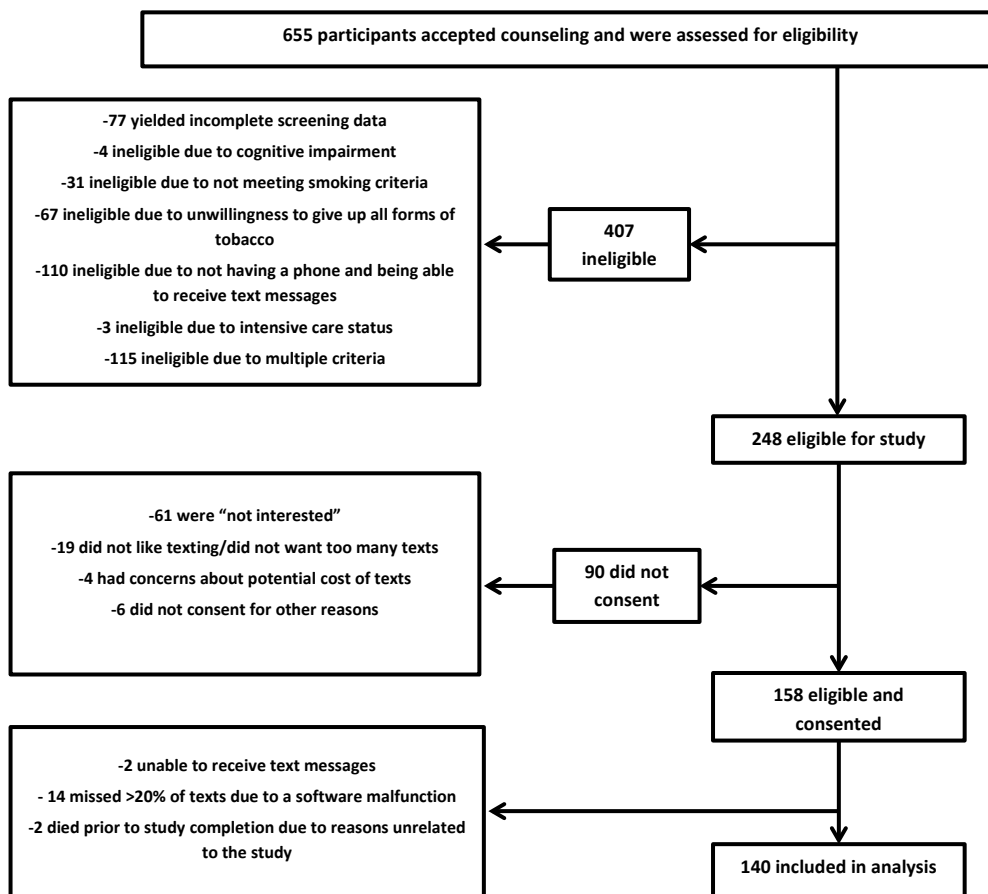


Table 1: Sample Demographics and Smoking Characteristics

Characteristic	Overall (n=140)	Control (n=70)	Intervention (n=70)	p-value
Mean age, (SD)	41.8 (13.2)	42.5 (13.3)	41.1 (13.3)	0.54
Female, n (%)	84 (60.0)	40 (57.1)	44(62.9)	0.49
White, n (%)	114 (81.4)	59 (84.3)	55 (78.6)	0.38
College degree or higher, n (%)	17 (12.1)	7 (10.0)	10 (14.3)	0.44
Mean cigarettes per day, (SD)	14.2 (9.97)	14.7 (11.2)	13.8 (8.6)	0.58
Median time (in minutes) to first cigarette, (range)	10 (0-720)	10 (0-720)	10 (0-120)	0.13
Mean Penn State Cigarette Dependence Index (PSCDI) score ^a , (SD)	10.8 (4.4)	10.6 (4.9)	11.0 (3.9)	0.61
Smokes menthol cigarettes, n (%)	82 (58.6)	38 (54.3)	44 (62.9)	0.30
Self-reported presence of symptoms/diseases caused or made worse by tobacco use, n (%)	52 (37.1)	29 (41.4)	23 (32.9)	0.29
Mean days since last cigarette, (SD)	4.6 (4.4)	4.7 (4.4)	4.6 (4.4)	0.82
Currently using smoking cessation medication, n (%)	38 (27.1)	17 (24.3)	21 (30.0)	0.45
Mean importance of quitting (range 1-10), (SD)	9.1 (1.5)	9.0 (1.4)	9.1 (1.6)	0.78
Mean confidence in quitting (range 1-10), (SD)	8.1 (2.2)	7.9 (2.3)	8.3 (2.1)	0.34
Concerned about gaining weight as a result of quitting, n (%)	69 (49.3)	33 (47.1)	36 (51.4)	0.61
Sends text messages most or every day, n (%)	125 (89.3)	60 (85.7)	65 (92.9)	0.17
Mean length of hospital stay (days), (SD)	5.3 (4.1)	5.7 (4.9)	4.9 (3.1)	0.25

SD = standard deviation; ^arange for PSCDI 0-20

Smoking Cessation Results

A summary of the smoking cessation results can be found in Table 2. Phone call follow-up data was obtained for 115 participants (82% of sample), 53 in the control group and 62 in the intervention group ($p=0.05$), at one-month post-discharge. Using intent to treat analysis on all 140 participants (70 per randomization group), self-reported quit rates at one month follow up were 43% ($n=60$), 40% ($n=28$) in the control group and 46% ($n=32$) in the intervention group ($p=0.49$). Biochemical verification via CO reading <10 ppm was offered to 31 of the participants who self-reported being quit. 10 participants refused biochemical verification and 21 completed the CO reading. 3 participants had a CO ≥ 10 ppm (readings 16, 20, and 24 ppm) and were classified as smokers. Based on intent to treat analysis, taking CO verification of a subsample of

participants into consideration, 41% (n=57) of participants were quit at one-month follow up, 37% (n=26) in the control group and 44% (n=31) in the intervention group (p=0.39). Of the 55 participants who self-reported relapse at one-month follow up, 85% (23 control and 24 intervention participants), reported resuming smoking within one week post-discharge (p=0.21). The most common reported reasons were “problems in personal life” (n=18; 33%) and “boredom” (n=11; 20%). The only baseline variables predictive of quit status at one-month follow up were age such that the younger the participant the more likely they were to be quit ($\beta = -0.03$; $p = 0.042$) and confidence in quitting such that the higher the participant rated their confidence in quitting successfully the more likely they were to be quit ($\beta = 0.25$; $p = 0.007$). Intervention group was not a significant predictor of abstinence at one month follow-up ($\beta = .19$; $p=0.59$).

Of those who completed the one-month follow-up phone call (n=115), 22 (19%) reported using a smoking cessation medication since the time of discharge, 11 in the control group and 11 in the intervention group (p=0.68). Medications used included the nicotine patch (n=14), nicotine gum (n=3), Chantix or Wellbutrin (n=3) and multiple medications (n=2). Quit rates did not differ between those who used a smoking cessation medication post discharge and those who did not (p=0.96).

Text Message System Results

A summary of the text message system results can be found in Table 2. 56% (n=94) of participants responded to at least four of the outcome questions and 35% (n=49) of participants responded to all outcome questions. There was not a significant difference in quit status between those who responded to all outcome questions and those who did not (p=0.46). During the course of the program, 12 participants (2 in the control and 10 in the intervention group; p=0.02) elected to stop the text messages. Participants stopped the messages an average of 12 days (range

1 to 25 days) into the 28 day program. Of those who stopped the text messages, 8 were classified as smokers and 4 as non-smokers at analysis.

Participant responses to text message smoking cessation questions at week one and four were cross-checked with information reported at one month follow up phone call in order to determine the concordance of responses. Of those who responded to the smoking status text message at one week post-discharge and completed the phone call follow-up (n=84), there was 86% agreement between text and phone call responses of smoking status at one week post-discharge. 6 participants reported not smoking within one week of discharge on the phone but did report smoking via text and 6 participants reported smoking within one week of discharge on the phone but reported not smoking via text. Of those who responded to the smoking status text message at four weeks post-discharge (which coincided with the timing of the phone call follow-up) and completed the phone call follow up (n=71) there was 92% agreement in responses regarding current smoking status. 5 participants reported not smoking at phone call follow-up but did report smoking via text message, and 1 participant reported smoking on the phone but reported being quit via text message. Of the three participants who failed CO verification of quit status, all three reported being quit at both phone call follow-up and four week text message.

Subjective reactions to the text messaging intervention collected at one month follow up phone call are also presented in Table 2. 20% (n=14) of intervention group participants interacted with the text messaging system by using the keywords mood, crave, or slip at least once. This feature was used an average of 2 times (range 1 to 8 times) per participant. There were no significant differences in the proportion of participants quit at follow-up between those who rated the texts as helpful, read all of the messages, recommended the texts for friends and family and interacted with the system compared to those who did not (all p-values > 0.1).

Responses to the open-ended questions regarding the text messaging system can be found in Table 3. Responses were obtained from 114 participants, 53 in the control group and 61 in the

intervention group. Of those who responded, 50.9% (n=27) in the control group found that the messages they received were helpful in reminding them that they were quitting smoking and helping to keep them on track. 49.0% (n=26) of responses in the control group indicated that participants wanted more messages/encouragement compared to just 5.0% (n=3) in the intervention group.

Table 2: Smoking Cessation and Text Messaging System Outcomes

Outcome Measure	Overall (n=140)	Control (n=70)	Intervention (n=70)	P-Value
^a Quit at 1 –month follow-up, n (%)	57 (40.7)	26 (37.1)	31 (44.3)	0.390
Responded to all outcome questions, n (%)	49 (35.0)	36 (51.4)	13 (18.6)	<0.0001
Texted “stop” during program, n (%)	12 (8.6)	2 (2.9)	10 (14.3)	0.016
^{bcd} Rated texts as ‘satisfactory’, ‘good’, or ‘excellent’ n (%)	103 (90.4)	44 (83.0)	59 (96.7)	0.014
^{bc} Would recommend similar texts to family/friends, n (%)	100 (87.7)	43 (81.1)	57 (93.4)	0.046
^{bc} Reported reading all messages, n (%)	96 (84.2)	46 (86.8)	50 (82.0)	0.481

^a Intent-to-treat analysis with biochemical verification of 21 participants ^bData only available for those who completed one-month follow-up; n=115 (control n = 53; intervention n = 61)
^c Intervention n=60 ^das compared to response of ‘poor’

Table 3: Open Ended Responses about Text Messaging System

Question: What aspects of the text messaging program did you find most helpful?		
<i>Comment</i>	<i>Control Responses (n=53)</i>	<i>Intervention Responses (n=61)</i>
Reminder of what you were doing/helped keep you on track, n (%)	27 (50.9)	12 (19.7)
Not helpful, n (%)	10 (18.9)	1 (1.6)
Encouragement/Support, n (%)	8 (15.1)	12 (19.7)
Texts providing suggestions for actions to take, i.e. when dealing with cravings, n (%)	0 (0.0)	16 (26.2)
Questions about smoking status, n (%)	4 (7.5)	4 (6.5)
All of it was helpful, n (%)	1 (1.9)	2 (3.3)
Informative messages, n (%)	1 (1.9)	7 (11.5)
Keywords/interactive aspect, n (%)	0 (0.0)	2 (3.3)
Convenient/good timing, n (%)	0 (0.0)	3 (4.9)
Texts about what you gain from quitting, n (%)	0 (0.0)	2 (3.3)
Don't Know	2 (3.8)	0 (0.0)
Question: In what ways do you think the text messaging program could be more helpful?		
<i>Comment</i>	<i>Control Responses (n=53)</i>	<i>Intervention Responses (n=61)</i>
More encouragement or more messages, n (%)	26 (49.0)	3 (4.9)
Fewer messages, n (%)	0 (0.0)	1 (1.6)
More interactive capabilities/reminders of interactive capabilities, n (%)	0 (0.0)	3 (4.9)
Change timing of messages, n (%)	0 (0.0)	3 (4.9)
More tailored to the individual, n (%)	0 (0.0)	3 (4.9)
Good as it is, n (%)	1 (2.0)	6 (9.8)
No ideas for improvement, n (%)	26 (49.0)	38 (62.3)
Other, n (%)	0 (0.0)	4 (6.6)

Chapter 4

Discussion

Although there was not a statistically significant difference in the proportion of smokers who quit at one-month follow-up between the control and intervention group, this study shows that texting may be a feasible method for following up with hospitalized smokers post discharge. Overall, a majority of participants responded to at least four of the five outcome questions and agreement was high between text message and phone call follow-up responses regarding smoking status. This indicates that text messaging may be a viable way for hospitals to collect information regarding smoking status post-discharge in order to satisfy the Joint Commission standards in the area of Tobacco Treatment. In fact, using this method may allow for more accurate reflections of smoking status. For example, agreement between text message response and one month follow up phone call response regarding smoking in the week after discharge was lower than agreement between text message response and one month follow up phone call regarding prior week smoking status. This could indicate that by the time participants are followed up with at one month post discharge, they cannot as accurately recall when they resumed smoking, and capturing this information using text message may be completed more frequently to ensure accuracy. Furthermore, some participants reported at phone call follow up that they had not smoked in the prior week but reported via text message that they had smoked. Text messaging may provide a data collection method through which participants feel more comfortable honestly reporting their smoking status as compared to having to report it directly to someone over the phone thus allowing for the reduction in social desirability bias [13].

It is important to note that participants in the intervention group who completed the one-month follow-up were more likely than those in the control group to rate the text messages favorably ($p=0.014$) as well as to say that they would recommend similar texts to family or friends who were trying to quit ($p=0.046$) indicating that those in the intervention group did find the program helpful. However, a majority of participants in the control group rated the texts favorably and reported they would recommend texts like this to friends or family looking to quit, implying that the control group did receive some benefit even from the limited texts received. Based on the qualitative responses, it appears that while the control group participants did want more messages, they found the outcome questions they received provided them with a reminder that they were trying to quit and helped hold them accountable. In this way, the control texts may have provided more benefit to participants than researchers previously anticipated which should be considered in the design of future interventions. There was not a significant difference in the proportion of participants who reported reading all of the text messages between the intervention and control groups and in both groups over 80% of participants reported doing so. This indicates that participants were receptive to text messaging as a way to receive information during their quit attempt.

This study also illustrates the importance of biochemical verification of quit status. 14% of participants who completed CO verification did not meet the <10 ppm requirement to be classified as a non-smoker. Other studies of text messaging smoking cessation interventions including Abrams et al. and Free et al. utilized biochemical verification via salivary cotinine using cut-off points of >15 ng/mL and >7 ng/mL respectively. These studies found that of participants who self-reported being quit at follow-up, 24.4% and 28% respectively failed the biochemical verification [8, 9]. In addition, ten participants refused to participate in biochemical verification despite provided compensation and researcher willingness to make the process as convenient as possible. It is possible that those unwilling to provide biochemical verification of

their quit status may not truly be quit. Consequently, self-report alone may not accurately reflect the true quit rates that are achieved by texting interventions and it is important to include biochemical verification on as many participants as possible through means such as saliva cotinine or carbon monoxide reading.

This pilot data provides valuable information about the implementation of text messaging smoking cessation interventions in an inpatient setting. It highlights that while texting is a feasible way to deliver smoking cessation information to patients discharged from the hospital it is important to consider ways to improve the intervention. Some studies have suggested it is beneficial to customize text messaging interventions in order to improve the relevance and salience of the messages [14-16]. This could include tailoring content based on participant smoking status at various points in the program so that those who have relapsed receive different content than those who have maintained their quit status [15]. Since hospitalized smokers are a very specific population, it may be worthwhile to implement a more individualized approach, potentially incorporating details about their reason for hospitalization and the importance of smoking cessation to their recovery in order to emphasize the participant's motivations for quitting. Unfortunately, in this study we did not have the capability to tailor intervention content based on participant responses which may improve the efficacy of the intervention, though it was mentioned as a suggestion for improving the intervention in our open-ended responses. Others have shown that focus groups prior to intervention implementation may help to gauge the interest and preferences of the target audience [17, 18]. The qualitative feedback obtained in this study may provide ideas which could be explored further as to ways that future text messaging interventions designed for a population of hospitalized smokers could be improved.

Further considerations for intervention delivery include the frequency and duration of the text messages. One meta-analysis found that fixed message schedules (receiving the same

number of text messages consistently for the duration of the program) may be more efficacious than a decreasing message schedule which is what was utilized in this study [14]. However, in this study we saw the majority of those who relapsed did so within the first week post-discharge, at which point they would still have been receiving the highest number of text messages. For post-discharge interventions involving phone call or in-person follow-ups, it was found that they were more effective when follow-up care lasted longer than one month post discharge [7]. This may be relevant to post-discharge interventions utilizing text messaging as well and thus it may be important to considering extending the follow-up period to longer than one month as was utilized in this study.

Another important factor is the setting of implementation. Participants were approached during their hospital stay and presented with the idea of quitting smoking, which they may not have been considering prior to their hospitalization. While other studies have found text messaging interventions are efficacious, they have not applied them to an inpatient population which may not have been as prepared for their quit attempt as those who may be seeking out help to quit smoking. This study also had a large proportion of participants who were ineligible at the time of screening. When implementing this type of intervention, it is important to carefully consider the inclusion criteria in order to most thoroughly reach the target population. For example, because this study utilized a newly designed text messaging system, participants were required to have a phone with them and charged so that researchers could ensure that the system was operating properly. With a more established text messaging system, this may not be necessary, allowing for inclusion of a larger population.

Chapter 5

Conclusion

This study provides preliminary evidence that text messaging is a potential method for providing smoking cessation information to and following up with smokers after they are discharged from the hospital. While the proportion of participants quit at one month follow-up were not significantly different between the intervention and control groups, participants viewed the intervention favorably and participated in the program via responses to smoking status follow-up questions that were well correlated with those reported at one month phone call follow up. As a result, text messaging may be a method to consider for hospitals seeking to meet Joint Commission standards in the area of Tobacco Treatment. The results of this study provide many opportunities to learn how to improve the implementation of text based smoking cessation programs in a population of hospitalized smokers including utilizing strategies such as tailoring the intervention content, utilizing a fixed message schedule, extending the follow-up period longer than one month and carefully defining inclusion criteria. In addition, researchers should consider the design of the intervention and control group as we saw that control group participants may have benefited even from the limited content received. Lastly, the study highlights the importance of biochemical verification of quit status of as many participants as possible in studies of text messaging interventions. Further research should be conducted in utilizing text based smoking cessation interventions in specialized populations such as hospitalized smokers.

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