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Building a Tailored Text Messaging System for Smoking Cessation in Native American Populations

Drew Williams
Marquette Univesity

Golam Mushih Tanimul Ahsan
Marquette University, golammushihtanimul.ahsan@marquette.edu

Ivor D. Addo
Marquette University, ivor.addo@marquette.edu

Sheikh Iqbal Ahamed
Marquette University, sheikh.ahamed@marquette.edu

Daniel Petereit
Rapid City Regional Hospital

See next page for additional authors

Authors

Drew Williams, Golam Mushih Tanimul Ahsan, Ivor D. Addo, Sheikh Iqbal Ahamed, Daniel Petereit, Linda Burhansstipanov, Linda U. Krebs, and Mark Dignan

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Drew Williams

Marquette University

Golam Mushih Tanimul Ahsan

Marquette University

Ivor Addo

University of Wisconsin – Oshkosh

Sheikh Iqbal Ahamed

Marquette University

Daniel Petereit

Rapid City Regional Hospital

Linda Burhansstipanov

Native American Cancer Initiatives

Linda Krebs

University of Colorado

Mark Dignan

University of Kentucky

Abstract

When starting new and healthy habits or encouraging vigilance against returning to poor habits, a simple text message can be beneficial. Text messages also have the advantage of being easily accessible for lower-income populations spread over a rural area, who may not be able to afford smartphones with apps or data plans. Users benefit the most from text messages that are customized for them, but personalization requires time and effort on part of the user and the counselor. However, personalization that focuses on the cultural background of a pool of recipients, in addition to general personal preferences, can be a low-cost method of ensuring the best experience for patients interested in taking up new habits. In this paper, we discuss the development of a system for motivating users to quit smoking designed for Native American users in South Dakota, using text messaging as a daily intervention method for patients. Our results show that focusing on modular message customization options and messages with a conversational tone best helps our goal of providing users with customization options that help motivate them to live happy and healthy lifestyles.

SECTION I.

Introduction

Smoking, long popular in the United States, is a particularly destructive habit: 16 million people in the nation live with a disease that was caused by smoking, and it results in 480,000 deaths a year. [1] While the prevalence of smoking has mostly gone down over the years, for one racial subgroup, the prevalence of smoking has in fact increased: American Indians and Alaskan Natives. [2] In 2013 alone, 43.8% of Native Americans in the United States reported using commercial tobacco, most frequently cigarettes. [3] As a result of this, a number of programs and groups exist aimed at assisting Native American tribes in particular in curbing this epidemic of smoking. [3]

In general, the act of smoking cessation often involves the breaking of a longstanding habit (smoking cigarettes), which can be a difficult task for individuals. Habits, repeated responses to ones environment that occur over time, often occur without conscious thought. [4] Unfortunately, this means that habits tend to repeat in the presence of those environments, regardless of an individuals motivation. [4] A number of practices, such as group therapy or discussion with a counselor can aid in motivating an individual to stop smoking. However, counselors cannot be around throughout a

patient's day to continuously motivate them, and consistency has shown to be an important factor in the formation of other good habits, such as gym attendance. [4]

However, with the recent rise in mobile devices and mobile computing comes a solution: text messaging. Users can be sent text messages over a span of time that inspire them to take initiative and not fall to poor habits - such as notifying them that they should take a walk, or drink water. This approach has proven to be beneficial in a number of cases [4] [5]. Furthermore, as most cellular phones come with the ability to send texts, they are a speedy and inexpensive method of reaching someone on their own time with a short message, making text messaging a potentially powerful tool in motivating a patient to engage in healthy and beneficial behaviors. [6]

An intervention that uses text messaging seems to be a perfect fit for Native Americans, who often are scattered across rural reservations and may not be able to travel frequently to appointments with counselors. However, we face several challenges to ensure that such an intervention is the most beneficial for a user. In particular, we looked at the following two research questions associated with the creation of such a system:

- How do we create a tailored messaging system that fulfills the needs of users interested in personalization without forcing them into personalization? Customization of text messages in behavior interventions is a must, as these usually are more beneficial for users than other approaches, [7] but some users may not (initially) be interested in such options.

- How do we create text messages that take into account the cultural sensitivities of this particular population? Native American smokers have the unique position of using natural tobacco in cultural ceremonies, and as a medicine amongst tribes.

In this paper, we present a smoking cessation system created for a population of Native American smokers in South Dakota, utilizing cultural sensitivity and phase targeting at its goal. In particular, we can summarize the main contributions of this paper as follows:

- Development of a system for customizing text messages using phase-targeting, cultural sensitivity, daily category selection and personalization.

- The effects of these messages as a supplement to a more structured general smoking cessation plan.

We begin by exploring our motivation for designing such programs, and related work surrounding the use of messaging and cultural sensitivity in behavior interventions. Next, we discuss the smoking cessation program's text messaging system: its place in the larger system, the system architecture and the design of individual texts that were a part of the system. We then discuss results from implementing this system, and in particular how the text messaging portion affected overall user satisfaction. Finally, we offer some concluding remarks about future directions for this work.

SECTION II.

Motivation

In developing this work, we were motivated to overcome two challenges that Native Americans might have in their smoking cessation journey: a lack of motivation to quit, and a lack of options that take into account the history that Native Americans have with tobacco. In doing this, we hoped to provide a motivating solution that preserved cultural identity for Native American smokers, and guide them towards a life without commercial cigarettes.

We chose to focus on text messaging as a vector of motivation, rather than the main force of the smoking cessation program. Text messaging has done well in this role in other studies in regards to behavior management [8] and works well to achieve our goal of reminders of a patients intent that interrupt daily life. As most users bring their mobile phones with them everywhere they go, motivational text messages can reach a patient in many circumstances where a counselor can not, such as during a stressful work meeting, where a user may be tempted to soothe frazzled nerves with destructive behavior. Additionally, text messages are inexpensive and fast. Most modern cell phones, including flip phones, support text messaging. Furthermore, messaging applications that can make phone calls, such as Google Voice [9] or Skype [10] also may support text messaging, allowing even those without smart phones to receive them. This can make using text messages in behavioral intervention more beneficial than other options, by increasing the number of folks who can benefit from these messages. Not all smart phone users can run messaging applications due to factors such as outdated operating systems or limited device space. Finally, as reservations are typically rural areas, our patients may not have a consistent and strong internet connection with which to download the new messaging application and the resulting messages.

We chose to focus on the tailoring of these messages to Native American culture in order to identify the need for any Smoking Cessation program to consider the cultural significance of tobacco products in Native American culture. Native Americans have long considered natural tobacco to be a medicine and frequently use it in prayer. [11] A poorly-designed Smoking Cessation program, which might demonize tobacco in its efforts to persuade patients to stop smoking, could be poorly received. This, compounded with existing negativity in the Native American community towards smoking cessation, [12] can be a death knell for these programs. Indeed, Fu et. al [13] found that Native Americans prefer the idea of a smoking cessation that includes elements of cultural tailoring. Its worth noting, however, that as studies opt for cultural tailoring, whether or not a study is successful is being shown to not only rely on culturally tailored work. Smith, et. al [14] constructed a culturally-sensitive smoking cessation utilizing varenicline as a medication for encouraging smoking cessation and individual counseling, and did not find clear evidence that indicated that the approach was strictly better. However, as our approach utilizes text messaging to help busy patients have daily motivation at their fingertips, we hope to see user enjoyment of our text messages.

SECTION III.

Related Work

We begin by discussing behavior-change theories that our work relates to, including the Theory of Planned Behavior (the basis for our study) and how our work fits into Michie et. als behavior Change Wheel. [15] Well also look at related studies that use text messaging in motivating positive behavior in individuals. Finally, we look at studies that focus on motivating indigenous populations in particular.

A. Behavior Motivation

The core of our system is based around the Theory of Planned Behavior, created by Icek Ajzen in order to attempt to understand how motivation affects behavior in individuals. [16] The theory uses three sets of variables - normative beliefs, control beliefs, and actual behavior control - to predict how people will act. [16] Normative beliefs refer to expectations of family and friends (and the public); control beliefs relate to outside factors that may influence whether a person can or cannot perform a task; and actual behavioral control refers to whether an individual actually has the ability to perform a task or not. [16] By tweaking the strength of one of these factors, one can motivate an individual to form healthy habits. For example, one may think they have no time for exercise, but by showing them how little time it takes to exercise in the morning and also how their friends and family would be proud of them for taking the healthy initiative to do such, one can motivate them to follow through on a new gym habit.

Its worth noting that since this theory entered the scene, a number of additional frameworks have sought to explain human behavior and categorize interventions in a more streamlined fashion. One of the more popular of these, which we can use to categorize our works, is the behavior change wheel. In 2011, Michie et. al [15] analyzed a number of studies in behavior change, to better understand how to categorize and formulate future studies in this work. The result was a behavior change wheel, which presents a number of different types of interventions to facilitate the improvement of three main areas of behavior: capability, opportunity and motivation. [15] Our work can be categorized neatly into this framework, as we focus on enhancing the physical opportunity for ones smoking cessation efforts: messages both persuade a patient to stop smoking using stories and facts about smoking, and incentive by offering examples of what a patient could stand to gain as a result of smoking cessation.
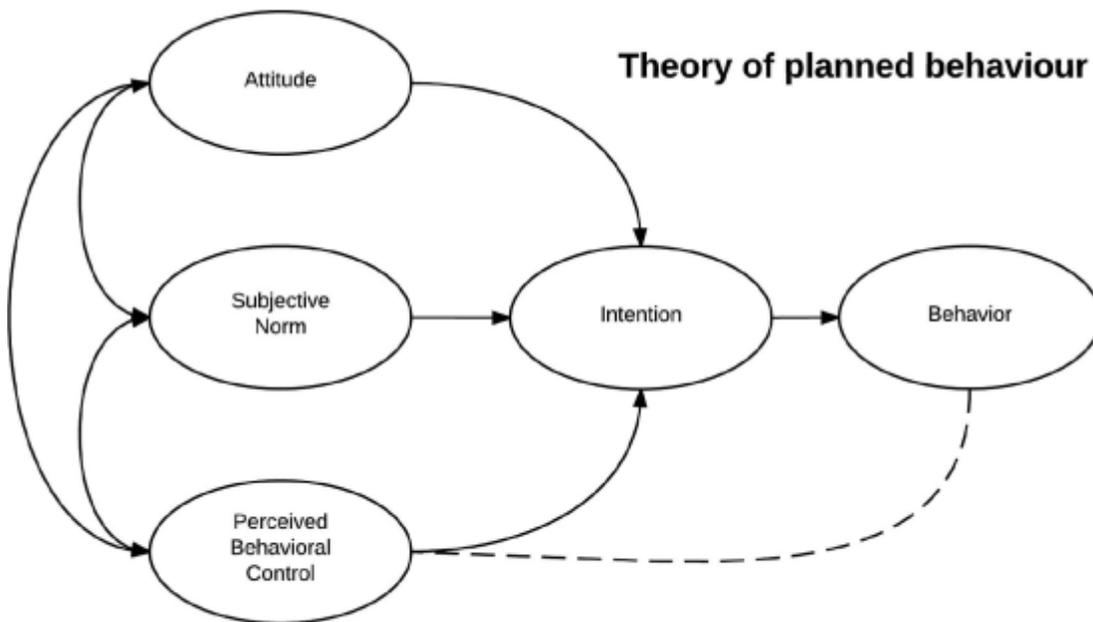
(a) A Diagram illustrating the tenants of the Theory of Planned Behavior. [17]

B. Use of Text Messaging in Behavior Interventions

Text messaging is a popular way to motivate individuals to take good care of themselves. Fjeldsoe, Marshall and Miller [18] assessed 14 studies of short message service (SMS) based intervention systems, and determined that using SMS to motivate behavior such as adherence to medication or exercise had promise, although further optimization of this method of motivation was needed. In 13 of the studies that were assessed, positive trends were seen as a result of using text messages to motivate users, with 8 of these positive trends being statistically significant. [18] Studies varied in patient retention and details, but some particular details were seen to be particularly helpful for SMS behavior motivation systems, such as tailoring the messages to the user. [18] Franklin, et. al [19] also found that using SMS messaging made it easier to reach young adults for the purpose of motivating self-directed management of Type 1 Diabetes. While the authors found that their system couldn't be proven to improve self-directed glycemic control, psychological measures that were "predictive of adherence" saw improvements, and the use of SMS messages was more "socially-acceptable" for this population of youth. [19] Another study wherein expecting mothers received free text messages assisting them with the ups and downs of pregnancy noted that using SMS was a strength of the program, due it the fact that it was "a popular and familiar technology." [5] Mothers were only sent a maximum of three messages a week, and no tailoring was applied to the messages. Despite this, 95% of participants stated they would recommend the service to a friend. [5]

In particular, text messaging has been found to greatly help individuals who are looking to stop smoking. Whittaker, et al. [20] found that smoking cessation programs integrating phone-based interventions were 1.7 times more likely to succeed in motivating a person to quit and remain smoke-free, although not all interventions examined were solely based around SMS messages - one used a phone-based reactive help line. [20] Likewise, a trial in which participants looking to quit smoking were randomly assigned to text messaging services encouraging them to quit or offering unrelated messages

found a significant increase in abstinence from smoking in the smoking-specific text messaging group. [21] Haug et al. [22] conducted a study of using texting in conjunction with a smoking cessation program for young adults, and found that participation and retention rates were high as a result of using text messaging as part of the intervention, although reimbursement per reply received to messages may have also been a factor.

It should be noted that tailoring was a popular subtopic when considering text messaging interventions. Tailoring referred to a number of methods, from broader messages that were applicable to an individuals phase of smoking cessation [23] to identifying personal needs and responding to them on a per-person basis. [7] Unfortunately, advanced tailoring of messages in technological interventions typically does not happen, despite work in the literature indicating that it would be a successful idea. [24]

C. Targeting Native Americans in Interventions

Interventions that target populations typically boil down to two ideas: discussion of the study with the community, and tailoring of the media within a study to the needs of a particular ethnic group. Many have found tailoring to be a positive addition to larger interventions. Lawrence et. al assessed a number of interventions where a particular ethnic minority was targeted and found that successful clinical studies were found to use a counseling component, and most non-clinical studies used multi-component interventions that involved tailoring to the ethnic group that they were targeting. Successful nonclinical studies did not involve tailoring, and involved heavy discussion with the community. [25]

Findings on the necessity of culturally-tailored interventions are mixed. Rodgers et al. [26] conducted a study using a mobile phone intervention with some degree of personalization based on patient preferences (using a keyword matching algorithm), and found that over twice the number of individuals in the trial quit smoking compared to a control group. In this study, 20% of the participants in this study were Maori, and the trial involved Maori researchers, kaupapa Maori methodology, and the use of Maori text messages related to health. Researchers ultimately found that the trial was as effective with Maori participants as non-Maori participants. [27] Johnston, et. al. investigated five studies to assess whether cultural adaptation of smoking cessation programs had an effect on the efficacy of the program, and noted that it was not always the case that such adaptations were needed. Furthermore, no study has pitted generic against culturally-tailored messages, so no real knowledge about performance in the absence of cultural targeting exists. [28]

However, the preference of Native American populations should absolutely be taken into account here, as existing negative beliefs can make this population suspicious of medicine and concerned about the continuation of historic racism - potentially affecting studies of how best to help individuals stop smoking. Gould, et. al assessed 21 studies of applying anti-tobacco messages towards indigenous populations, and assessed that culturally targeted messages were indeed preferred. [29] It was noted that indigenous researchers in particular argue that lack of culture awareness in programs targeting indigenous populations may not fully capture the indigenous experience. [28] Its also deemed preferential to have individuals of the target population as part of the study cohort. Fu, et. al [13] found that participants in a study focusing on Native American attitudes towards Smoking Cessation

recommended to the researchers that individuals of Native American descent with experience in smoking cessation *lead* studies in the future.

In light of this user preference towards involving the culture of Native Americans in text messages, we opted to focus on this method of personalization in our text messaging studies. We focused on an overall conversational tone, with the ability for the user to select the desired level of customization during their study visit. We also worked in different messages for the phase targeting part of our study. All in all, we hoped to bring a user-desired level of message tailoring to our work, while also continuing to build the system with modularity and stability in mind, so it might be adapted for users from all backgrounds.

SECTION IV.

Methodology

Our experiment took place with Native Americans living in South Dakota, due to the high prevalence of smoking amongst the inhabitants of this area. Participants interacted with counselors over a period of sixteen weeks, during which they received maintenance medication, and a combination of different levels of counseling, text messaging, and a nicotine patch or oral NRT. [30] In this section, we explore details of the study, and how our messaging was woven into the grander scheme of things.

A. Participants

The study involved 256 patients from Native American reservations in South Dakota. We requested that potential participants had a desire to stop smoking within three months, could travel to counseling sites, would only use our smoking cessation program, and could receive and respond to text messages. Users did not have to have a phone, as we provided study participants with a temporary phone for the duration of the study. Participants were from both genders and from different age groups. Figure 1a shows the gender distribution. Figure 1b shows the frequency of age participants. Figure 1c shows their smoking history in years.

B. Experiment Design

As mentioned, the study included nicotine therapy, counseling and mHealth (text messaging interventions) with a phase-based framework. We separated the cessation process into four phases - motivation, pre-cessation, cessation, and maintenance. Users were divided into 16 individual groups, where the intensity of each of the portions of the study - counseling before and after quitting, text messaging, and NRT/nicotine patch use - was varied between an intense application and a minimal application. As an example, text messages for those in the intense text messaging group were sent four times daily; for the minimal group, they were only sent twice a day.

The outcomes for the study were tied to the in-person counseling appointments, which occurred 11 times throughout the duration of the study. These were coupled with an assessment of the individual's carbon monoxide level, to determine if they had smoked at all during the period of time they'd been away, and a survey that was given at the end of the visit. This survey asked a number of questions of the individual, such as whether or not they felt parts of the study were helping them (i.e. the text messaging portion, for example).
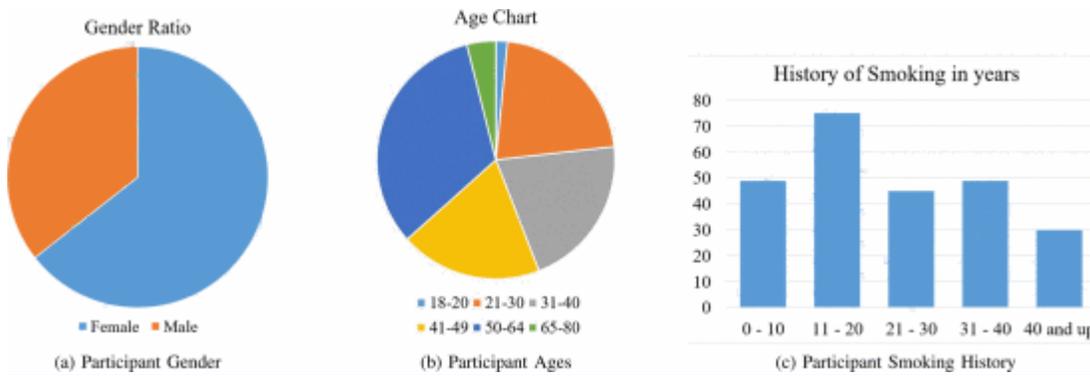
Fig. 1.

Demographic information of the participants.

While the participants were not meeting with counselors, they received a daily digest of motivating messages - some generic, others tailored to their culture, and in later parts of the study, a few created by the users themselves.

All-in-all, participants were in the study for eighteen months.

C. System Architecture

The smoking cessation system was comprised of four main layers: the user layer (consisting of researchers, administrators, counselors and patients), the application layer (which included the method for sending SMS messages), the integration layer, and the data layer. The data layer consisted of an SQL Azure database in the Azure Cloud, which was chosen due to it being HIPAA compliant. [31] The integration layer was located in the Microsoft Azure cloud service, and consisted of ASP.Net web APIs, which converted JSON and XML survey responses to stored data in the Azure database. This layer communicated with the data layer to make changes in the database and collect information about different participants from the database, such as what stage of the program they were in, and their preferences for text messages. At the application level, a web portal existed to make it easy for administrators and researchers to access user data according to their role. Administrators and researchers were also able to watch progress and other reported information on behalf of the participants. Also included at the application layer was an iPad survey application, which helped collect data from participants via assisting the research team in conducting surveys at various points throughout the patients' cessation programs. By relying on an iPad for data collection, we lessened the probability that data would be lost or rendered unreadable by accident in the process of survey taking. This level also included our SMS server, which sent and received messages using a re-purposed Nexus 4 android phone. Finally, the user layer consisted of participants, and the study's researchers and administrators, who accessed the system through the application layer according to their access level.

D. System Functionalities

Each participant was added to the system via the baseline survey given at the patient's initial visit, which also registered the participant into the system. During visit 2, the participant was assigned a phone to receive text messages. Some text messaging options were also selected during these surveys,

and the participants were given the opportunity to create customized text messages at this and following visits. Each morning after the patient initially agreed to receive text messaging, the text messaging server sent a daily text message, allowing a user to pick a daily preference for type of message to be received. Upon receiving their reply, the server changed the setting of that participant for that day and select a random text message from the pool of messages with correct text messaging setting. An Android application acting as a gateway finally sent the message to the participant, and received messages sent by participants to the service, facilitating two way communication between them. Sent and received text messages were also stored in the server for future queries. The researchers and the administrators accessed this information depending on their role in the system.

E. SMS Message Design

The messages that were available for the user to choose from were critical to the effectiveness of the SMS program. We wanted to have a wide variety of text messages, so users would have the ability to fully customize their intervention depending on their desires and the stage of the program in which the user was involved. As a result, we had a number of categories of text messages, with different groups within each of these categories. Users could choose categories of messages to receive texts from, and particular groups were selected each morning via the aforementioned wake-up message. Messages were also split across the different phases of cessation.

Categories ranged from Strategies and General Motivation, to our culturally-sensitive traditional messages. General messages were crafted without any ties to storytelling or the tribal beliefs in the area, and often tried to impart particular facts about smoking. Examples of general messages are as follows:

- "Don't smoke! Fish, birds, and other small animals can mistake cigarette butts for food and become poisoned"

- "Chewing tobacco is as harmful as smoking tobacco. It can cause oral cancer and problems with your teeth"

- "Don't try to quit cold turkey. 95% of those who try cold turkey fail. Cutting down is one way to help yourself quit"
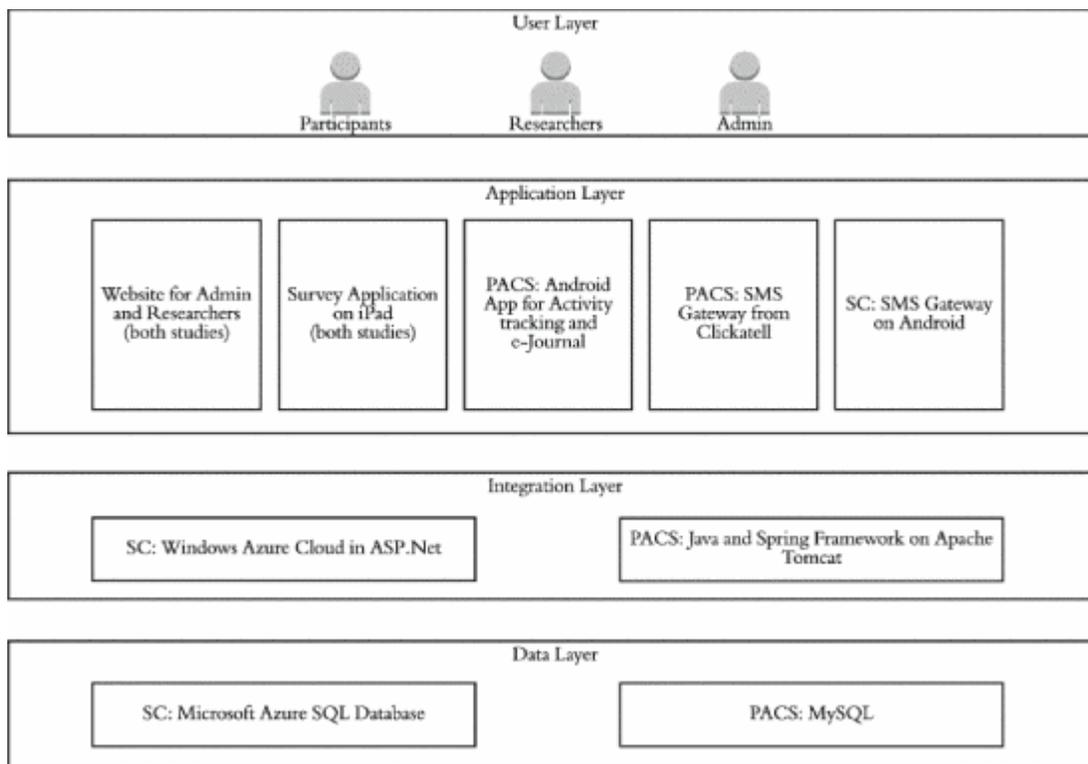
Fig. 2.

Overview of system architecture

Traditional messages were crafted while taking into account the Native American traditions and activities of the population that this study targeted. Roughly half of the messages in the total set were grouped into the traditional category. [30] Examples of traditional messages were:

- "Stop smoking to show respect for tobacco as a sacred gift from the Creator."

- "I want to stop smoking so I can honor my ancestors and those I love"

- "I want to stop smoking so I can honor my life through healthy living"

All in all, 129 users opted to select traditional messages.

Daily customization options included reminder-type messages, messages relating to quitting or cravings users may experience during the day, and tips for going through the smoking cessation experience. Even further customization was available, as users had the option in their meetings with counselors to add their own messages as they saw fit. These were often reminders of friends or family members that reminded them of their reasons for wanting to quit smoking, and appeared more frequently than other messages. Less users than expected took advantage of this option. [30]

SECTION V.

Results

A. Health Outcomes

As mentioned, during several of the survey visits the participants used a breathalyzer to detect the level of carbon monoxide in their exhaled breath. From the results, we see that the level of carbon monoxide in the exhaled breath decreased as patients made progress in the study. During visits at the start of the study, the average carbon monoxide reading was 14.08. When the study was finished, the average reading for patients who still were involved in the study went down to 5.25. This was a helpful indicator that overall, the system helped individuals in stopping (or reducing) participant smoking frequency.

B. System Evaluation

At the end of select appointments with a counselor, patients were asked how helpful they believed the text messaging system was to them. The response was generally positive - the question was asked a total of 442 times and less than 3% of users disagreed to an extent on the effectiveness. On the other hand, about 89% of the replies indicated some agreement with the messages being helpful. The pattern is relatively universal among the groups receiving minimal (two messages a day) and intense (four messages a day) numbers of text messages.

However, how many users utilized the advanced customization options of the text messaging system? From the database, we were able to determine that over 70,000 of the morning text messages were sent and 40% were replied to, meaning only those 40% of patients requested daily customization for their messages. This rate of reply may be due to the fact that participants receive text messages regardless of their day's preferred selection. If they were busy, they could still receive categories of messages selected at their counseling appointments. Additionally, phone problems, such as damaged phones [30] or phones with connectivity problems, caused problems with text message receipt throughout the course of the study. In any case, even without topical customization in the morning, messages from the categories selected during their counselor visits were sent along. In this way, a soft customization was active for participants, even without their explicit daily customization responses.

Table I User responses regarding effectiveness of text messages in smoking cessation study.

Visit	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
3	1	4	1	18	11	90	45
4	0	1	0	8	3	37	19
5	0	0	1	4	5	40	19
6	0	2	1	3	5	32	22
7	0	0	1	1	1	12	7
9	0	1	0	1	3	8	10
10	0	1	0	1	3	9	3
11	0	0	0	0	1	5	3
Total	0	9	4	36	32	233	128
Percentage	0.00%	2.04%	0.90%	8.14%	7.24%	52.71%	28.96%

Visit	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
3	1	4	1	18	11	90	45
4	0	1	0	8	3	37	19
5	0	0	1	4	5	40	19
6	0	2	1	3	5	32	22
7	0	0	1	1	1	12	7
9	0	1	0	1	3	8	10
10	0	1	0	1	3	9	3
11	0	0	0	0	1	5	3
Total	0	9	4	36	32	233	128
Percentage	0.00%	2.04%	0.90%	8.14%	7.24%	52.71%	28.96%

There were two further results we examined to evaluate whether participants found the text messaging portion of our study helpful. One was the presence of customized messages, which the users wrote themselves in order to motivate themselves on a personal level. These messages ranged from reminders of family members who were proud of them quitting, to simply motivating messages written in the user's own words. The participants created 36 customized messages in total, and they were sent to them more than 1200 times.

Additionally, we noticed that we received impromptu feedback from the system, as a result of the nature of the messages we received and sent. Messages were constructed to be very conversational to help patients feel less like a computer was checking up on them and more like a friend. As a result, we often got messages from participants ranging from apologies for giving in to a craving, thanking us, or validating that they in fact did feel good not smoking. In future work, we'd like to be able to parse this feedback with natural language processing, and perhaps develop a conversational system, which might also help the smattering of users who expressed dissatisfaction with the automated nature of the messages (which could not be disabled by the user as part of the study).

SECTION VI.

Discussion

Despite our best efforts, a number of challenges cropped up during this study that were not foreseen, including damaged and lost phones [30] and poor connectivity on the reservation that affected message transmission. Some study participants also only pretended to be smokers in order to obtain the phones that were handed out as part of the study. [30] However, amongst those who completed study counseling sessions, the text messages were frequently received in a friendly manner. Customization was frequently used and our hierarchy lent itself to advanced personalization on a per-person basis. If an individual wasn't sure of what they wanted from personalization, they could pick categories of messages and enjoy a randomized selection. If they had an idea of specific challenges they might face on particular days, they could opt in for particular messages for cravings or tips for staying away from cigarettes, and receive on-demand help. Finally, those who had a reason for stopping smoking that was close to their heart could remind themselves of this reason with customized messages.

Thus, with half of the participants choosing to receive traditional messages, we were able to verify the same results as past studies: Native American users enjoy having culturally-sensitive options in their intervention programs. The conversational aspect of the messages was such that users would respond to the messages as if a friend was talking with them; an illusion that may have been propagated by the

existence of traditional messages. As past studies have done, we ensured that development of the traditional messages involved tribal member input, so we could ensure they would be helpful to study participants.

However, we did note that cultural tailoring should not only happen at the text messaging and counseling level, but at the system design level as well. Text messaging was chosen in part because it would be less affected by poor connectivity than a messaging app that used WiFi, so in a way the existence of our challenges with poor connectivity validated our decision to pick texting over a more feature-heavy messaging application. Additionally, the selection of texting meant that, in the event that the application was related for wider consumption, the tribal populations would be able to utilize it regardless of income as most cellular phones are compatible with text messaging. Considering a population's resources is a great way to develop an appropriate solution for them.

On the note of releasing the text messaging application created, it's also worth noting that word of mouth meant that there was demand for the application prior to the study being conducted, and when the team members bring up the project. [30] This was not at all expected, but does prove that Native American populations are excited to have technological approaches to managing smoking. Once the app has been thoroughly tested, the research team would like to disseminate it more widely and call attention to its availability.

A. Future Work

If this study were revisited in the future, the affects of multi-media messaging would be a great place to investigate. Like text messaging, this feature is available on most modern phones, and as Native American imagery was a requested part of culturally-tailored interventions [13] it might be a welcome addition to text messaging. Traditional video might show activity that an individual could do in lieu of smoking, such as the basket-weaving mentioned in our existing set of traditional messages. Alternatively, it might distract the viewer with a story for the duration of time a nicotine craving takes place; typically 10–20 minutes. [32] In addition to video, guided audio meditations, graphics, or other media might be considered.

Additionally, a system of implementing natural language processing server-side to parse and respond to user messages that come in would be a great way to enhance our user experience. In short, we would be creating a sort of text messaging chat bot. Doing this could be greatly beneficial for motivating users. Such chat bots already exist for managing mental health on the Facebook messaging platform [33] and general fitness via an Android application. [34] Building system fault tolerance into modules of a behavior management system (i.e. allowing for a set of "backup" messages for the SMS service to be stored, in the event the Azure database goes down) could decrease the likelihood of a day without service for the user. Especially in the event these applications were rolled out more publicly, this should be considered, as it may help users feel they have a friend they can rely on during the smoking cessation process.

SECTION VII.

Conclusion

In conclusion, we have presented the results to develop a smoking cessation system utilizing text messaging, with messages that were culturally-tuned to Native American populations in the Northern Plains of South Dakota. In conjunction with counseling and NRT, we sent text messages that could be customized by users, and offered fine-tuned customizations for deployment of culturally-sensitive messages and user-specified text messages alike. Text messages sent were met with a favorable response, with about 40% of users customizing messages on a per-day basis.

A system of customization was developed in which users were offered a choice in the types of messages they received. As expected, some users opted for customization, but if they weren't sure what sort of support they wanted from the text messaging portion, they were not forced to. Traditional messages were offered, created with tribal member input, which considered the beliefs of users in the area. Furthermore, half the participants chose to receive traditional messages, proving that, as in prior studies, the existence of culturally-sensitive material was beneficial for many participating in this study. Cultural tailoring also affected our study design, and by taking into account the rural population of our users, we were able to minimize service outages by relying on text messaging instead of WiFi.

In the future, we'd like to consider multimedia messaging and the development of an automated chat system to enhance the positive effects that we saw in this study. Automated chat would be lower-cost than having on-demand counselors texting to patients, and media could serve as a useful distraction as users attempt to quit smoking. In any case, keeping in mind the cultural backgrounds of the populations we target with interventions is a fantastic way of inspiring trust in study participants; without which, help is difficult to offer.

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