Evaluation of a Mobile Device Survey System for Behavioral Risk Factors (SHAPE)

BACKGROUND

Early mitigation of specific risk factors for poor health, such as limited exercise, poor sleep, smoking, and alcohol use, can prevent serious long-term health consequences. Across the United States, 25% of adults smoke [1]. With only 21% of US adults meeting recommended levels of physical activity, [1] it is not unexpected that over a third (35.8%) are overweight [2]. Alcohol abuse and dependence are highly prevalent, [3-5] as are serious mood disorders [6] and illegal drug abuse [7]. Although there are smartphone applications that measure many risk factors [8-12], there is currently no ability to rapidly collate the results of these measurements to determine population-specific risk prevalence that can be used for public health planning and interventions.

Risk prevalence is currently measured through telephone surveys using methods such as Random Digit Dialing (RDD) that now faces ever-diminishing participation rates among eligible subjects and bias due to migration from landlines to mobile phones. [13]. The Behavioral Risk Factor Surveillance System (BRFSS) [14] is the largest RDD survey in the U.S., with 500,000 annual respondents, but it has suffered a 20 percent drop in response rates during the past decade [15]. Nonresponse can vary significantly across different demographic and geographic groups with adjustment procedures coming at the expense of diminished precision [16]. As in many other fields (including pre-election polling), phone surveys are increasingly unreliable and the search for a modern-day alternative is justified to ensure continuity of valid measurements. Collecting survey data using smartphone apps may offer many advantages, including the potential to collect geo-positioning, scanning, photo and video data. Over 75 percent of Americans now own a smartphone [17] and underrepresented groups have often been quick to adopt this technology and forgo landlines [18].
Mobile app survey development methodology is a growing area of interest, and while few papers have been written that detail specific development steps [19], Buskirk and Andrus [20] presented an outline of app-based smartphone survey approaches and Davis and Oakley-Girvan [21] have provided strategies to improve testing and validation of mobile apps which include: iterative testing, enhanced user engagement, reduced burden, and appropriate infrastructure to reduce downtime and meet Health Insurance Portability and Accountability Act (HIPAA) privacy and confidentiality of personal health information requirements.

OBJECTIVE

In response to these shortcomings, our study focused on developing, implementing, and pilot testing a mobile survey system to collect behavioral risk data, and address the following questions:

- **Feasibility** – Can the target population be recruited to download and use the app?
- **Usability** – Can an app be developed that is easy for people to understand and quick to use?
- **Acceptability** – Will respondents allow access to phone captured ambient data?
- **Validity** – How well do the app data correspond to traditionally collected data from the target population?

The hypothesis was that utilizing an iterative development and testing approach would yield an effective app with low burden and high acceptability to collect behavioral health and demographic characteristics consistent with previous benchmarks. This paper presents the results of this pilot study that address the four questions provided above.

The goals were to develop a mobile application to administer behavioral health-related surveys on iOS (Apple) and Android platforms with at least 500 pilot users from three small northeastern colleges and at least 20 behavioral health-related survey questions. The evaluation was developed to include: a
process to encourage individual enrollment/adopter of the mobile app, a mechanism to invite users to respond to consecutive short surveys, and the ability to pull location from the user’s mobile phone.

METHODS

Study Protocol Summary

The study population was students enrolled in one of three Vermont State Colleges (Castleton University (CU), Lyndon State College (LSC), Johnson State College (JSC)). In the summer of 2016, we conducted a focus group among CU students (n=9) to elicit suggestions concerning branding, color scheme, and a name for the app (ultimately named “SHAPE”). Based upon this input the study team created four versions of the SHAPE app (iOS standard, iOS gamified, Android standard, Android gamified) to collect behavioral health data. Survey questions focused on demographic characteristics and behavioral health items consistent with available benchmark data. A multi-pronged approach was used to recruit student participants during a 22-day period in October 2016. Additional details on recruitment methods are included in the section below entitled “participant recruitment.” Similar to traditional telephone surveys, where the informed consent is administered after the potential study subjects answers the phone, SHAPE participants were administered informed consent as part of the app download and eligibility determination process. Eligible participants (age 18 or older with an email domain at a participating institution) that consented were administered the first survey. Two additional surveys were pushed out over a period of several weeks. A total of 27 items were asked across three surveys, the last of which included questions regarding the SHAPE app functioning and the survey process. Focus groups were conducted post app data collection to understand how the students liked the app, and why they did or did not respond to the surveys. Students (n=7) were recruited in person by the on campus recruiter, and eight open-ended questions were discussed.

Survey Questions
Survey questions for which benchmark data were already available from the traditionally administered Vermont College Health Survey included (VCHS) [22] and included questions related to general health behavior (physical activity and sleep), mental health (depression and stress), and substance use (alcohol, marijuana, tobacco, cocaine, and methamphetamine use). Demographic items (age, gender, race/ethnicity, year in school, and residence) were also selected from the VCHS. Additional questions were developed regarding how respondents learned about the SHAPE app, motivation for participation, evaluation and "adoptability" of the app [23]. The items were divided into three surveys. Demographic, mental health, and health behavior items (15 items total) were asked in the initial survey. The second survey included questions on substance use (7 items). The final survey asked items related to evaluating and providing feedback about the app (5 items).

Marketing/Branding

Student employees of the Castleton Polling Institute created some preliminary names and logos for the app to present to the pre-app focus group. This focus group provided information to guide the logo, color scheme, and name selection of the app. Polling Institute student employees helped create general marketing messages and recruitment materials. Prior to the app launch, additional iterative usability research was conducted within the research team and with six CU students to gather feedback on the app prototype as well as the draft marketing strategy, messages, and recruitment materials.

Participant Recruitment

A website landing page was created to facilitate easy app download and to ensure that participants were randomly assigned to receive either the gamified or standard versions of the app. The landing page included links to the SHAPE app in both Apple’s and Android’s app stores, a FAQ section about the project, a link to the consent form, and contact information for questions or assistance. Google Analytics and unique links were created to track traffic to the page for each of the recruitment
methods. At the launch of the project, approximately 1,000 full color flyers were placed at the three campuses in varying locations. Student recruiters were hired at all three campuses to encourage participation. Student recruiters were provided leaflets with the landing page link and bookmarks as recruitment aids. CU and JSC published advertisements for the app in their school newspaper, three emails were sent to all CU students with links to the landing page, and LSC included recruitment materials in their electronic weekly student newsletter. In the final week of recruitment, targeted Facebook ads were purchased for five days at CU. A lunchtime pizza give away at JSC and LSC campuses was hosted.

**Implementation: Security and Data Collection**

The study protocol was approved by all three colleges’ Institutional Review Boards (IRBs). In addition the project received administrative approval by all three institutions’ Presidents as well as approval from the Vermont State College System’s legal counsel. Medable, a medical software development company, provided a HIPAA compliant backend platform that allowed secure storage and transmission of data and a business associate agreement that meets US Department of Health and Human Services requirements for the protection of human subjects.

As part of the eligibility and consent process, participants were asked their age and institutional email address. A respondent was eligible if he or she was 18 years of age or older and provided an email address that used a participating institution’s domain. Eligible respondents were asked if they would allow push notifications (messages sent by the SHAPE app to the device but not required), and then given the option to begin the first survey or to resume at a later date and time. The first survey remained open during the enrollment period. Any enrolled participant who did not fully complete Survey 1 received push notifications (if they had allowed the notifications on their device) as reminders to
complete the survey. A total of four push notifications were included during Survey 1’s field period (October 10, 2016 to October 31, 2016).

All eligible respondents, regardless of completion of Survey 1, received a push notification at the start of Survey 2, and three additional reminder push notifications. Because of low initial response to Survey 2 with only push notifications, three reminder emails were sent during the second field period (November 17 to November 27, 2016). Survey 3 launched on November 30, 2016. All enrolled participants, regardless of previous survey completion, were asked to complete Survey 3. The notification protocol included an initial survey push notification, three reminder push notifications, and three email reminders. Survey 3 closed on December 8, 2016.

**Evaluation of feasibility, usability, acceptability, and validity**

Iterative testing of applications for each platform (iOS and Android) was conducted over 16 weeks. Each application had two versions, the standard version (only the survey items) and a gamified version (the survey items plus a simple point system) with acceptance on the iOS and Android app stores. The SHAPE app was developed using Swift (for iOS) and Android Studio (for Android), and was compatible with iOS 8+ and Android 4.x+. Medable’s Axon product for Research Kit was used for iOS and Research Stack was used for Android.

From the Medable HIPAA compliant backend the researchers were able to manage users, create questions and response options, and push notification scripts. The Medable backend captured real-time responses to the survey items as well as all data related to the game (points), and all paradata (date/time starting a survey, date/time ending a survey, geolocation, etc.).

Qualitative data (e.g., focus groups, user interface/user experience testing, and interviews) were audio recorded and reviewed by the project team [24]. Data from the VCHS 2014 survey was compiled
RESULTS

Feasibility: Participant Characteristics

There were 1392 “hits” to the landing page where the app could be downloaded. Excluding known project testers and others not part of the population of study, 670 apps were downloaded. Of those 670, 636 participants (95%) agreed to participate by providing in-app consent. Of the 636 that consented, 536 (84%) were deemed eligible for the study. The majority of eligible respondents completed the initial survey (86%). Similar to longitudinal studies, the highest rate of attrition occurred between Survey 1 and Survey 2. Thirty percent of respondents completed the second survey and 29% of respondents completed the third survey. As reported by Miller and Oakley-Girvan and others (Survey Research in Press 2018) 88% of respondents were from the primary location, the majority were iOS system users (82%) and the sample was deemed representative of the target population., CU (n=472).

The majority of eligible respondents completed the initial survey (86%), 30% completed the second survey, and this held steady with 29% completing the third survey. The distribution of year in school was significantly different between completers (those completing all three surveys) and non-completers (those completing only one or two surveys), with 12% more third year participants completing all three. White non-Hispanic students completed at a higher rate (26%) than did students who indicated another race/ethnicity group (11%). The rate of completion among gamified app respondents and standard app respondents was nearly identical (23.1% to 22.8%), indicating that the pilot test gamified design did not reduce the attrition rate.

Validity: Comparison to the Benchmark Survey (VCHS)
The data collected from the SHAPE mobile app were compared to the results for CU students obtained from the 2014 VCHS because results from the 2016 survey were not yet available for analysis. Because not all of the 2014 survey items were the same as the items asked in 2016 (and thus repeated in this project), analyses was restricted to comparisons when the 2016 questions were either identical or had very minor differences in wording compared to the 2014 questions. This analysis focuses on respondents from the primary site (CU) due to small numbers of participants from JSC and LSC. The SHAPE app items had low item non-response rates, similar to response rates from the 2014 VCHS.

A total of 209 CU students responded to the 2014 VCHS. In comparison to enrollment numbers, the age distribution was similar in both VCHS and SHAPE. Women were overrepresented in VCHS data by 22% compared to 2014 enrollment, while women were only minimally overrepresented (2%) in the SHAPE app. VCHS data included a slightly higher proportion of international students than in total enrollment (+4%), compared to slightly lower in the app (-3%). White, Non-Hispanic respondents were overrepresented in VCHS data by 10%, and underrepresented by SHAPE by 7%. Interestingly, the app improved upon capturing race/ethnicities other than White and had almost double the number of anticipated respondents to survey 1 compared to the 2014 VCHS.

Some examples of health and behavior items that were included on both the 2014 VCHS and in the SHAPE app project were:

- “On how many of the past 7 days, did you perform moderate intensity exercise for at least 20 minutes?”
- “On how many of the past 7 days, did you perform vigorous intensity exercise for at least 20 minutes?”
- “On how many of the past 7 days, did you perform exercises to strengthen your muscles (8-10 exercises each for 8-12 repetitions)?”
• “How often have you used cigarettes?”*
• “How often have you used alcohol?”*
• “During the last [reference period], how many times have you had five or more drinks of alcohol at a sitting?” (The reference period is 2 weeks in the VCHS and 30 days in SHAPE.)
• “How often have you used marijuana?”*
• “How often have you used cocaine (e.g., crack, rock, blow, freebase)?”*
• “How often have you used methamphetamine (e.g., meth, crystal, ice, crank)?”*

* Note: response options were not the same, but were collapsed into comparable categories for analysis

The mean number of days in the past seven days that the subject engaged in moderate or vigorous physical activity was slightly higher among SHAPE app respondents than VCHS participants, (see Table 1). The median for all three physical activity items in the VCHS data was one day less than the SHAPE app data. Compared to the 2014 VCHS data, fewer app respondents indicated smoking cigarettes in the past 30 days (8% versus 16%) and more app respondents selected the “never used” category (74% versus 68%).

**Table 1. Behavioral Health Characteristics of Castleton SHAPE App Participants Compared to Results from the Vermont College Health Survey Administered in 2014**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>2016 Castleton SHAPE App Respondents (n=414 survey 1, n=143 survey 2)</th>
<th>2014 Castleton VCHS Participants (n=209)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical Activity, Past 7 Days</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Moderate intensity exercise for at least 20 minutes (number of days) | Mean: 3.11  
Median: 3  
SD: 2.38 | Mean: 2.56  
Median: 2  
SD: 2.18 |
| Vigorous intensity exercise for at least 20 minutes (number of days) | Mean: 2.54  
Median: 2  
SD: 2.41 | Mean: 1.90  
Median: 1  
SD: 1.98 |
<table>
<thead>
<tr>
<th>Performed Exercises to Strengthen Muscles (number of days)</th>
<th>Mean: 1.88</th>
<th>Median: 2</th>
<th>Mean: 1.71</th>
<th>Median: 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD: 2.07</td>
<td></td>
<td>SD: 2.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of times had five or more drinks of alcohol at a sitting (SHAPE last 30 days, VCHS last 2 weeks)</td>
<td>Mean: 1.87</td>
<td>Median: 0</td>
<td>Mean: 1.02</td>
<td>Median: 0</td>
</tr>
<tr>
<td>SD: 2.67</td>
<td></td>
<td>SD: 1.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cigarette Smoking, Frequency of use</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Never used</td>
<td>106</td>
<td>74%</td>
<td>139</td>
<td>68%</td>
</tr>
<tr>
<td>Used, but not in last 30 days</td>
<td>26</td>
<td>18%</td>
<td>34</td>
<td>17%</td>
</tr>
<tr>
<td>Used in last 30 days</td>
<td>11</td>
<td>8%</td>
<td>33</td>
<td>16%</td>
</tr>
<tr>
<td>Alcohol Use, Frequency of use</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Never used</td>
<td>17</td>
<td>12%</td>
<td>24</td>
<td>12%</td>
</tr>
<tr>
<td>Used, but not in last 30 days</td>
<td>27</td>
<td>19%</td>
<td>25</td>
<td>12%</td>
</tr>
<tr>
<td>Used in last 30 days</td>
<td>98</td>
<td>69%</td>
<td>156</td>
<td>76%</td>
</tr>
<tr>
<td>Marijuana Use, Frequency of use</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Never used</td>
<td>53</td>
<td>37%</td>
<td>108</td>
<td>53%</td>
</tr>
<tr>
<td>Used, but not in last 30 days</td>
<td>47</td>
<td>33%</td>
<td>42</td>
<td>21%</td>
</tr>
<tr>
<td>Used in last 30 days</td>
<td>43</td>
<td>30%</td>
<td>55</td>
<td>27%</td>
</tr>
<tr>
<td>Cocaine Use, Frequency of use</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Never used</td>
<td>129</td>
<td>91%</td>
<td>191</td>
<td>93%</td>
</tr>
<tr>
<td>Used, but not in last 30 days</td>
<td>10</td>
<td>7%</td>
<td>8</td>
<td>4%</td>
</tr>
<tr>
<td>Used in last 30 days</td>
<td>0</td>
<td>2%</td>
<td>7</td>
<td>3%</td>
</tr>
<tr>
<td>Methamphetamine, Frequency of use</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Never used</td>
<td>142</td>
<td>100%</td>
<td>199</td>
<td>98%</td>
</tr>
<tr>
<td>Used, but not in last 30 days</td>
<td>0</td>
<td>0%</td>
<td>4</td>
<td>2%</td>
</tr>
<tr>
<td>Used in last 30 days</td>
<td>0</td>
<td>0%</td>
<td>1</td>
<td>1%</td>
</tr>
</tbody>
</table>

The same percent of respondents in both surveys (12%) selected the “never used” alcohol category. VCHS subjects had a larger proportion of respondents indicating alcohol use in the previous 30-
day period compared to the app respondents (76% and 69%, respectively). The reference period for the binge drinking item was different in the two surveys: the previous 30 days for the app, and the previous two weeks for VCH Survey. The app respondents had a higher mean (1.87) compared to VCHS (1.02). Given the longer reference period (30 days versus 2 weeks), it is reasonable to expect an increase in mean days reported for the app respondents.

A larger proportion of app respondents reported marijuana use compared to VCHS (63% and 48%, respectively). The pattern in responses for cocaine use between the two data sets is similar, with slightly lower frequency of "never" and "last 30 day" users among app respondents, and a slightly higher rate in the "used but not in the last 30 days" category (3%) compared to the VCHS results. All respondents indicated that they had "never used" methamphetamine in the app compared to 98% in VCHS.

Acceptability: Paradata Findings

For Survey 1, 38% of respondents completed the survey when the app was launched. Another 30% completed it after the third push notification. For the second and third surveys, the highest survey completion rate came with the arrival of the first reminder email. The overall time to project completion was an average of 37.6 hours, and an average of 11.6 hours to completion for surveys 2 and 3. Nearly 90% of users (87%) completed Survey 1 in less than five minutes with the median and modal response time of only two minutes. Surveys 2 and 3 were completed in one minute or less by the overwhelming majority of respondents.

Ambient data such as geolocation was easily captured for all users. There were three large data clusters centered near the three institutions that participated in the study. Two smaller clusters appear in Manhattan and Connecticut during Survey 1, but these are likely non-GPS information. Survey 2 was
fielded over the Thanksgiving holiday. By utilizing the geolocation data, we could see how much more dispersed the physical location of respondents was pre- and post-holiday. See Figure 1.
Feasibility and Usability: Study Participant Feedback

In survey 1, respondents were asked "How did you hear about this project" and were given a list of options to select all that applied. The most frequently selected category (54%) was from someone else, followed by 28% indicating a flyer on campus, 15% via email, 14% a flyer in the bathroom, 11% somewhere else, and 1% via Facebook.

Respondents were also asked an open-ended question, "What is the primary reason you decided to download this app?" Thirty-eight percent of respondents' responses were categorized as "told about it by someone" with the "altruistic motivation" category closely following with 35% of responses. The "personal reward" category had 11% of responses, "general interest/curiosity" had 10%, "other" 5%, and "marketing materials" was at 2%.

The final survey was designed to gather evaluation data about the app. Results indicate that the app experience was positive. The majority of respondents (80%) indicated that they would prefer to
participate in surveys with an app on their phone compared to other modes of survey participation.

Respondents were asked "How much do you think you should be paid for downloading the app and answering the survey?" The results indicate nothing or a small amount under $5 is preferred. Twenty-eight percent of respondents were categorized as "promoters" based on their response to the question "How likely would you be to recommend this app to a friend?"

**Usability: Focus Group Post-App Follow-Up**

Participants in a focus group and interviews held after the close of all three surveys frequently stated that the app was easy to use and was intuitive. Those who completed the surveys and those who only partly completed them all expressed that they expected more frequent surveys. When asked about the number of questions per survey, participants were satisfied with the length. Nearly all respondents wanted at least the option of seeing the results of the surveys after completing them and to understand how they "compared" to their fellow students.

**DISCUSSION**

In this study, we were successful in rapidly recruiting participants with an initial group of 536 eligible participants. In fact, the number of participants for CU on the behavioral risk items was 414 for survey 1, almost double the 209 CU participants who completed the VCHS in 2014. The survey app resulted in higher than usually observed response rates for longitudinal surveys [29].

Multiple technical successes were achieved throughout the app development process indicating high feasibility for rapid development. Guidelines for successful mobile app development were followed [21], including involving the study population in the development process through focus groups and interviews, iterative user interface and usability testing, field testing, and post-field testing follow-up through user focus groups. Medable removed multiple barriers (cost, time, technical knowledge and
HIPAA requirements) as a rapid mobile app development tool and a backend platform focusing on data security.

We were also able to capture GPS data from participants' phones. This highlights the exciting future potential to include additional sensor data to add richness to a dataset instead of just relying on self-report. Geocoded information combined with health information could open up the potential for additional analyses, such as the impact of the place or the neighborhood where people live on physical activity, diet and drug use. The neighborhood environment has been shown to have an additional and distinct effect from individual characteristics [30-32].

Participants in the post-survey focus groups viewed the app as being easy to use, engaging, and low-burden. However, this information was gathered from those that completed all three surveys and we do not have data from the participants that completed just survey 1 and/or 2. In future work, we plan to assess the experience at the end of each survey with a few simple questions.

This project successfully demonstrated that almost 25% of a college population would download the SHAPE app and that researchers could make the survey experience low burden while maintaining validity that is comparable to more expensive and burdensome efforts. Once study subjects downloaded the app, they were impressed with the speed and ease of entering their survey responses. Every indication suggests that the data collected were of good quality as both the correspondence between the app survey responses and the available benchmark comparisons were nearly identical and there was a low item non-response in all surveys. A limitation of this work is that we were unable to compare raw VCHS data to our mobile app survey data due to limited release of the VCHS data and thus because the samples were not entirely independent (although approximately 50% of the college population would likely have graduated) we did not conduct specific statistical testing of means and proportions or other summary measures.
While the population selected for this study is not representative of the general US population, it is a well-defined and enumerated population. The study population closely mirrored the entire college population on which this study was focusing. However, because this app survey mechanism relies on voluntary download, this could potentially introduce a selection bias in other populations and deserves further study. In addition, multiple recruitment methods were used that required in-person efforts which may be difficult in larger communities. Gamification, which was one of the controlled variables, was underdeveloped and did not result in any difference in survey response. The mobile app survey mechanism that this project developed has great potential for future research, but requires further evaluation of potential barriers in broad population groups, particularly those that may be difficult to reach through current telephone and paper-based methodologies. Recruiting a broad community-based population sample of subjects to download an app and consent to a data collection protocol will require additional methodological investigation, particularly as it relates to branding and social-media peer marketing.

Behavioral health assessment surveys collected via smartphone apps have great potential; very few respondents were lost during the consent and registration processes following download and most were likely the result of addressable technical and log-in challenges. The ability of smartphone users to “turn-off” notifications may have resulted in lower participation numbers for surveys 2 and 3 and should be addressed. Future possibilities include the ability to capture passively collected background data such as accelerometer, and other ambient information. This information could proactively inform health providers, provide optimal resource allocation at the state and national agency level, as well as personalized information for a wide variety of health needs and health improvement objectives such as exercise, weight and sleep.

CONCLUSION
This paper describes the development and pilot testing of a mobile application (app) to administer behavioral health-related surveys on iOS and Android platforms targeting college students in Vermont.

There are three key findings:

1. It is feasible to engage a large proportion of the study population to download the SHAPE mobile app, complete consent and eligibility determinations, and complete behavioral risk survey items. The survey was completed by 523 participants (25% of the population). The SHAPE mobile device survey system was also very effective at including typically underrepresented groups.

2. Survey responses on behavioral risk items were valid as they were consistent with more expensive, larger survey efforts conducted using time consuming methods. This paper compares CU app respondents with CU VCHS participants on seven major behavioral risk items[22]. Not only were the data valid, SHAPE was also deemed acceptable as it also captured ambient and real-time data that is not possible using conventional survey methods.

3. Mobile app survey systems can be usable with low burden and quick response rates that includes ambient data such as geolocation. The average time to overall project completion was 37.6 hours, with an average of 11.6 hours to completion for surveys 2 and 3. Once participants engaged in a survey, nearly 90% completed the survey in less than five minutes. Based on data from questions in survey 3, and from post-survey focus groups and interviews, the participants found they were low burden, welcomed more engagement and questions, felt motivated by civic mindedness, and generally were not concerned about being paid to participate. Students also preferred to do a survey through an app on their phone compared to other modes of survey administration.
In summary, new techniques are emerging in survey methodology for public health and research. The private sector has moved ahead of the public sector on survey innovations. The Internet and social media have become powerful methods of gathering information from consumers; voice recognition software allows businesses to offer rewards to consumers who call in to respond to surveys throughout the day. At the same time, participants are becoming resistant to cold calls in the evening as telemarketing increases its pressure on the public. The goal of this pilot study was to determine if early adopters of smartphone technology would be likely to download an app to participate in a behavioral health survey. From this pilot study, we learned that this is a methodology that these early adopters of smartphone technology could employ. The next step in the evolution of this technology and the methodology is to test this on a broader general population. This method alone will not be the sole means of collecting general population health data, but rather a supplement. Currently, there is no one mode of data collection that can be used to conduct general population surveys. Even in-person only studies, which are prohibitively expensive for most researchers and government agencies, are limited in capturing data during daily life activities and suffer from erroneous self-report for certain sensitive information. As public health research research evolves, leveraging current technologies to supplement data collection modes will be essential in order to capture rich and meaningful datasets and address non-response bias, and coverage issues.

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**Competing interests** None.

**Ethics approval** The SHAPE project pilot test was approved by the Institutional Review Boards of Castleton University, Lyndon State College, and Johnson State College, as well as all three institutions' Presidents and the Vermont State College Systems legal counsel.

**Providence and peer-reviewed** Not commissioned; externally peer-reviewed.

**Disclosures**: Dr. Oakley-Girvan is employed part time by Medable Inc. but did not receive any funding from Medable for her role on this project nor did she engage with Medable app development staff during app development.

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