Understanding Patients’ Intention to Use Digital Health Apps That Support Postdischarge Symptom Monitoring by Providers Among Patients With Acute Coronary Syndrome: Survey Study

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Abstract

Background: After hospital discharge, patients with acute coronary syndrome (ACS) often experience symptoms that prompt them to seek acute medical attention. Early evaluation of postdischarge symptoms by health care providers may reduce unnecessary acute care utilization. However, hospital-initiated follow-up encounters are insufficient for timely detection and assessment of symptoms. While digital health tools can help address this issue, little is known about the intention to use such tools in ACS patients.

Objective: This study aimed to assess ACS patients’ intention to use digital health apps that support postdischarge symptom monitoring by health care providers and identify patient-perceived facilitators and barriers to app use.

Methods: Using email invitations or phone calls, we recruited ACS patients discharged from a central Massachusetts health care system between December 2020 and April 2021, to participate in the study. Surveys were delivered online or via phone to individual participants. Demographics and access to technology were assessed. The intention to use a symptom monitoring app was assessed using 5-point Likert-type (from strongly agree to strongly disagree) items, such as “If this app were available to me, I would use it.” Responses were compared across demographic subgroups and survey delivery methods. Two open-ended questions assessed perceived facilitators and barriers to app use, with responses analyzed using qualitative content analysis.

Results: Among 100 respondents (response rate 8.1%), 45 (45%) completed the survey by phone. The respondents were on average 68 years old (SD 13 years), with 90% (90/100) White, 39% (39/100) women, and 88% (88/100) having access to the internet or a mobile phone. Most participants (65/100, 65%) agreed or strongly agreed that they would use the app, among which 53 (82%) would use the app as often as possible. The percentage of participants with the intention to use the app was 75% among those aged 65-74 years and dropped to 44% among those older than 75 years. The intention to use was higher in online survey respondents (vs phone survey respondents; odds ratio 3.07, 95% CI 1.20-7.88) after adjusting for age and access to technology. The analysis of open-ended questions identified the following 4 main facilitators (motivations): (1) easily reaching providers, (2) accessing or providing information, (3) quickly reaching providers, and (4) consulting providers for symptoms, and the following 4 main barriers: (1) privacy/security concerns, (2) uncomfortable using technology, (3) user-unfriendly app interface, and (4) preference for in-person/phone care.

Conclusions: There was a strong intention to use a symptom monitoring app postdischarge among ACS patients. However, this intent decreased in patients older than 75 years. The survey identified barriers related to technology use, privacy/security, and the care delivery mode. Further research is warranted to determine if such intent translates into app use, and better symptom management and health care quality.
Introduction

The transition from inpatient care to home is challenging for patients with acute coronary syndrome (ACS) [1-3]. After hospital discharge, ACS patients often experience symptoms that prompt them to seek acute medical attention [2-6]. A large portion of these symptoms are noncardiac [3-7], and could be assessed and managed through close follow-up care in the outpatient setting to reduce unnecessary acute care utilization [3,5-7]. Symptom assessment and management are integral to transitional care [8-13], and are also part of the transitional care management services supported by Medicare [14]. However, hospital-initiated follow-up activities alone may be inadequate to detect symptoms in a timely fashion, as new or worsening symptoms may occur between the initial contact and the follow-up appointment [15]. Intensive transitional care programs offering multiple follow-up phone calls or home visits may better capture patient’s symptom episodes [11,12], but providing such thorough contact increases the need for staff resources and time, and can be challenging to scale up.

Digital health tools for symptom monitoring can support timely detection and evaluation of patients’ symptoms [16-20], and have been successfully integrated with routine cancer care [16,17,21-23]. Some tools allowed patients to report symptoms frequently or at any time [16,17]. However, in general, evidence about the feasibility and efficacy of using these tools to improve patient outcomes is still limited, especially in patients with ACS. A recent study analyzed data related to using a digital symptom monitoring tool (which allowed patients to self-rate and track their symptoms of fatigue) to enhance a patient-centered care intervention for cardiac rehabilitation [24]. This study found that the enhanced intervention improved patient-reported self-efficacy at 6 months postdischarge, compared with usual care (P=.01). However, only 39% of the patients in the intervention group chose to use the digital health tool.

More research is needed to understand the intention, barriers, and facilitators to digital health symptom monitoring in ACS patients. This is particularly true among older adults (≥65 years old) representative of the ACS population. Older adults have unique barriers in using technology, such as lack of knowledge and confidence, age-related changes or disabilities, and skepticism about the benefits [25,26]. Prior studies showed that most patients, including older adults, are ready to accept digital health tools for monitoring mental health conditions and symptoms, but the intention to use decreased with age [27,28]. Understanding these issues may help improve design, development, and adherence to digital symptom monitoring in ACS patients.

This study aimed to assess ACS patients’ intention to use digital health tools that support symptom monitoring by providers after hospital discharge. We conducted a survey, using both close-ended and open-ended questions, to assess the intention to use, the difference in the intention by patient characteristics (eg, age), and the facilitators and barriers of using these tools in this patient population. We also compared the intention to use between 2 survey delivery modes (online vs phone).

Methods

Study Design

We analyzed data collected through a survey using both close-ended and open-ended questions. The survey was delivered using 1 of the 2 modes (online surveys and phone calls) to ensure a balanced sample of participants who are comfortable or are not comfortable with the use of technology (ie, filling online surveys).

Ethics Approval

The study was approved by the Institutional Review Board at the University of Massachusetts Chan Medical School. The ethics approval number (ie, the Institutional Review Board Docket Number) for this study is H00018298. The Institutional Review Board approved the use of informed verbal consent procedures. We obtained verbal informed consent from each participant by email or phone.

Survey

The survey design was informed by prior literature on assessing participants’ intention to use digital interventions [29,30]. One researcher (with expertise in health informatics and implementation science) created the initial survey by adapting a subset of validated questions from a survey assessing participants’ intention to use mobile apps for COVID-19 symptom monitoring [30]. A cardiologist and 2 research team members (with training in public health and clinical research, respectively) reviewed the survey content and provided feedback on clarifying and simplifying the language of the introduction paragraph, the survey questions, and the response options.

The final survey (Multimedia Appendix 1) included 5 items to assess participants’ demographics (age, sex, and race) and access to technology (internet and smartphone), and 5 items (3 close-ended and 2 open-ended questions) related to the intention to use a hypothetical symptom monitoring app. The demographics questions and the open-ended questions were optional. Intention to use the app was assessed using a 5-point Likert-type (from “strongly agree” to “strongly disagree”) item (also called the intention-to-use question) as follows: “If this app were available to me, I would use it.” Participants who responded “strongly agree,” “agree,” or “neutral” to this item were prompted to respond to 2 additional items. The first item was a 5-point Likert-type item as follows: “I plan to use this app as often as necessary,” with response options ranging from “strongly agree” to “strongly disagree.” The second item was multiple-choice as follows: “I’d like the app to be designed as …,” with the following 3 options: “mobile app,” “web app,” and “other.” The 2 remaining open-ended questions collected...
free-text comments on the facilitators (ie, motivations) and barriers to using the app.

**Recruitment and Data Collection**

We recruited patients from UMass Memorial Health Care, the largest health care system in Central Massachusetts, serving most patients hospitalized with cardiovascular diseases in this region.

Using information from electronic health records (EHRs), we identified adult patients (>18 years old) who were hospitalized for ACS (ICD-10 codes: I24.9, I21, I21.x, I21.xx, and I25.110) between January 2019 and December 2020, as eligible participants. Study data were collected and managed using REDCap electronic data capture tools hosted at the study institution [31,32].

We recruited participants with a 2-stage procedure, using emails and phone calls, respectively. In the first stage (December 2020), we emailed invitations to 782 candidate participants. Once a participant replied to the email to indicate their interest, we sent the online survey via a secure REDCap link to their email address. An unanswered survey was automatically disabled in REDCap 30 days after being sent to the participant. Recruitment stopped after more than 40 participants responded to the online survey.

In the second stage (January 2021 to April 2021), we recruited participants who did not have an email address listed in the EHR via phone calls. Recruitment calls were made to 448 candidate participants until the total number of responses to the survey (from both email and phone recruitment) met the target (N=100). For phone recruitment, we documented the reasons for declining participation. Participants recruited by phone were given the option to complete the survey online (using the same procedure described for stage 1) or via phone. For surveys answered by phone, a research staff member documented participants’ verbal responses in REDCap. Each survey participant (for both stages of participant recruitment) was provided a US $10 gift card to compensate for their time.

**Research Questions**

The following 4 research questions were considered: (1) Do patients have the intention to use the app for symptom monitoring by providers? (Q1); (2) Is there a difference in the intention to use the app for symptom monitoring across subgroups characterized by participants’ characteristics, including age and access to technology? (Q2); (3) Is there a difference in the intention to use the app for symptom monitoring between participants responding to the survey online and those responding by phone? (Q3); and (4) What are the main factors that motivate or discourage patients’ use of an app for symptom monitoring by providers? (Q4).

**Statistical Analyses**

Statistical analyses were performed using STATA/IC 15.1 (StataCorp). We first calculated descriptive statistics of participants’ characteristics and examined their distributions over the 2 survey delivery modes. We then analyzed the data to answer research questions 1 to 3. We used participants’ age information from the EHR, which has greater granularity than the survey responses, for these analyses.

First, we calculated descriptive statistics of participants’ responses to the 3 close-ended survey questions related to the intention to use the symptom monitoring app (Q1). Second, we examined the distribution of the intention to use over participants’ characteristics and access to technology (Q2). Third, we assessed the associations between survey delivery mode and participants’ intention to use the app (Q3), using multivariable logistic regression to adjust for potential confounding factors related to participants’ characteristics and access to technology. We identified the confounders based on the literature and the examination of the distribution of participants’ characteristics over survey delivery mode (P<.05). In addition, we combined access to the internet and access to a smartphone into 1 variable, access to technology, when adjusting for the association analysis because the 2 variables are interdependent (Fisher exact test P<.001).

When conducting analyses related to questions 2 and 3, we grouped the 5 response options of the intention-to-use question into 2 categories, with 1 representing “agree” and “strongly agree” and 0 representing the other options. In addition, we assigned numeric values to the 5 response options (1: strongly disagree, 2: disagree, 3: neutral, 4: agree, 5: strongly agree) and presented the summary statistics of the responses.

**Qualitative Analyses**

To answer research question 4, we analyzed survey responses to the 2 open-ended survey questions through an iterative process using qualitative content analysis. Qualitative content analysis is a research method widely used to analyze written, verbal, or visual communication messages through the systematic coding and identification of themes or patterns [33-35]. Following established techniques [34,35], we carried on the analysis over 3 phases (ie, preparation, organizing, and reporting).

In the preparation phase, GEE (premed student with training in biology, neuroscience, and clinical research) read through the survey responses and assigned initial codes to the responses. JC (with expertise in health informatics and implementation science), JGW (with training in public health and health education), and GEE discussed the initial coding results and created the initial codebook. Using the initial codebook, GEE, JGW, and LML (with training in clinical research and neuroscience) coded all survey responses independently. Codes were assigned to each response (primarily single sentences), and double coding was allowed. The coded responses were discussed among GEE, JGW, LML, and JC to resolve discrepancies, and new codes were added when necessary. This process resulted in the final codebook (Multimedia Appendix 2), with 9 codes (4 categories) for the facilitator question and 8 codes (4 categories) for the barrier question. Based on the coding results, JC segmented survey responses into units that entail a single code. Most segments were single sentences; some were phrases or contained multiple sentences.

In the organizing phase, JC and JGW independently coded the segments using the final codebook. The intercoder agreement was assessed by comparing the codes assigned by JC and JGW and discussing discrepancies. The intercoder agreement was then calculated using the final codebook.

**:05).”}

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In the organizing phase, JC and JGW independently coded the segments using the final codebook. The intercoder agreement
was 86% for the facilitator question and 87% for the barrier question. Discrepancies were discussed and resolved between JC and JGW to generate the final coding results.

In the reporting phase, we reported the definitions, frequencies, and representative quotes of codes and summarized key findings [34,35]. We identified the major barriers and facilitators to app use by considering code/category frequency and existing literature on health app use among patients or older adults, and through discussion in the research team. In addition, we compared the most salient facilitators and barriers for the following 2 age groups: younger and older than 65 years of age.

**Results**

**Participant Characteristics**

Among 782 patients contacted by email, 59 (7.5%) showed interest in participating in the study, and 48 (81%) of them responded to the survey. Among 448 patients contacted by phone calls, 61 (13.6%) showed interest, and 52 (85%) of them responded to the survey. Overall, the survey response rate was 8.1% (100/1230). There was no difference in age between patients who responded to the survey and patients who did not, including those who did not show interest in participating in the study (67.6 vs 67.7 years, \( P = .94 \)). Of the patients contacted for this study and who did not want to participate, 73 provided reasons for nonparticipation. The common reasons included poor health condition (n=31, 42%), no interest (n=17, 23%), no time (n=11, 15%), and no access or uncomfortable with the use of technology (n=9, 12%).

Among 100 respondents, 45% (ie, 45 of the participants recruited by phone) completed the survey by phone and 55% completed it online. The respondents were on average 68 years old (SD 13 years), with 90% (90/100) White, 39% (39/100) women, and 88% (88/100) reporting having access to the internet or a mobile phone. As shown in Table 1, the rates of access to the internet (\( P < .001 \)) and a smartphone (\( P < .001 \)) were higher in online survey respondents than phone survey respondents. Among the 62 older participants (\( \geq 65 \) years old), 49 (79%) and 41 (66%) reported having access to the internet and a smartphone, respectively.

### Table 1. Participant characteristics overall and by the survey delivery mode.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total (N=100), n (%)</th>
<th>Survey delivery mode, n (%)</th>
<th>( P ) valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td>.82</td>
</tr>
<tr>
<td>&lt;65 years</td>
<td>38 (38)</td>
<td>16 (36)</td>
<td></td>
</tr>
<tr>
<td>65-74 years</td>
<td>32 (32)</td>
<td>14 (31)</td>
<td></td>
</tr>
<tr>
<td>( \geq 75 ) years</td>
<td>30 (30)</td>
<td>15 (33)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td>.41</td>
</tr>
<tr>
<td>Female</td>
<td>39 (39)</td>
<td>20 (44)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>59 (59)</td>
<td>24 (53)</td>
<td></td>
</tr>
<tr>
<td>Not reported</td>
<td>2 (2)</td>
<td>1 (2)</td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td>&gt;.99</td>
</tr>
<tr>
<td>White</td>
<td>90 (90)</td>
<td>39 (87)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>6 (6)</td>
<td>3 (7)</td>
<td></td>
</tr>
<tr>
<td>Not reported</td>
<td>4 (4)</td>
<td>3 (7)</td>
<td></td>
</tr>
<tr>
<td><strong>Has access to the internet</strong></td>
<td></td>
<td></td>
<td>&lt;.001b</td>
</tr>
<tr>
<td>No</td>
<td>15 (15)</td>
<td>14 (31)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>85 (85)</td>
<td>31 (69)</td>
<td></td>
</tr>
<tr>
<td><strong>Has a smartphone</strong></td>
<td></td>
<td></td>
<td>&lt;.001b</td>
</tr>
<tr>
<td>No</td>
<td>25 (25)</td>
<td>19 (42)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>75 (75)</td>
<td>26 (58)</td>
<td></td>
</tr>
</tbody>
</table>

aCalculated by the Fisher exact test for categorical variables, using complete case analysis (ie, ignoring missing values for gender and race).

bStatistically significant (\( P < .05 \)).

**Intention to Use the Symptom Monitoring App**

All participants (N=100) responded to the intention-to-use survey item, with responses of strongly agree (n=19), agree (n=46), neutral (n=15), disagree (n=15), and strongly disagree (n=5). A total of 74 participants responded to the survey item “I plan to use this app as often as necessary,” with responses of strongly agree (n=22), agree (n=35), neutral (n=16), disagree (n=1), and strongly disagree (n=0). Among the 65 (65%) respondents with a positive intention (agree or strongly agree)
to use the app, 53 (82%) agreed or strongly agreed that they would use the app as often as possible. Among the 73 respondents to the app design question, 28 (38%) preferred a mobile app, 30 (41%) preferred a web-based app, 14 (19%) liked both mobile and web-based apps, and 1 (1%) preferred another design (unspecified).

**Intention to Use by Patient Characteristics**

Among the 62 older participants (≥65 years old), 37 (60%) reported having the intention to use the app. As shown in Table 2, survey respondents aged 75 years or older had a lower rate of intention (ie, agree or strongly agree) to use the app (43%) than those in other age groups (74% for ages under 65 years and 75% for ages 65-74 years; Fisher exact test \( P=.02 \)). There was no difference in the intention to use by gender or race. The rate of the intention to use the app was higher in respondents with access to the internet or a smartphone than those without access (72% vs 17%, \( P<.001 \)).

The mean (Table 2) and median (Multimedia Appendix 3) scores of the intention to use and the distributions of the 5 levels of the intention to use (Multimedia Appendix 3), stratified by participant characteristics, showed similar patterns.

**Table 2.** Distribution of the intention to use a symptom monitoring app by patient characteristics and the survey delivery mode.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Response score(a), mean (SD)</th>
<th>Rate of a positive (agree or strongly agree) intention to use the app</th>
<th>(P) value(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n/N)</td>
<td>(%)</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td></td>
<td>65/100</td>
<td>.02(d)</td>
</tr>
<tr>
<td><strong>Age group</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;65 years</td>
<td>3.9 (0.8)</td>
<td>28/38</td>
<td></td>
</tr>
<tr>
<td>65-74 years</td>
<td>3.7 (1.1)</td>
<td>24/32</td>
<td></td>
</tr>
<tr>
<td>≥75 years</td>
<td>3.1 (1.3)</td>
<td>13/30</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Female</td>
<td>3.6 (1.0)</td>
<td>25/39</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3.6 (1.2)</td>
<td>39/59</td>
<td></td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
<td></td>
<td>.66</td>
</tr>
<tr>
<td>White</td>
<td>3.6 (1.1)</td>
<td>59/90</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>3.3 (0.8)</td>
<td>3/6</td>
<td></td>
</tr>
<tr>
<td><strong>Has access to technology (internet or a smartphone)</strong></td>
<td></td>
<td></td>
<td>&lt;.001(d)</td>
</tr>
<tr>
<td>No</td>
<td>2.2 (1.0)</td>
<td>2/12</td>
<td>17</td>
</tr>
<tr>
<td>Yes</td>
<td>3.8 (1.0)</td>
<td>63/88</td>
<td>72</td>
</tr>
<tr>
<td><strong>Survey delivery mode</strong></td>
<td></td>
<td></td>
<td>.001(d)</td>
</tr>
<tr>
<td>Phone</td>
<td>3.1 (1.3)</td>
<td>21/45</td>
<td>47</td>
</tr>
<tr>
<td>Online</td>
<td>4.0 (0.8)</td>
<td>44/55</td>
<td>80</td>
</tr>
</tbody>
</table>

\(a\)The gender and race variables had 2 and 4 missing values, respectively.

\(b\)Scores assigned to the response options were as follows: 1, strongly disagree; 2, disagree; 3, neutral; 4, agree; 5, strongly agree.

\(c\)Calculated by the Fisher exact test for all the items.

\(d\)Statistically significant (\(P<.05\)).

**Intention to Use by the Survey Delivery Mode**

The rate of a positive intention to use the app (Table 2) was higher in online survey respondents than in phone survey respondents (80% vs 47%, \( P=.001 \)). After adjusting for age and access to technology, the difference remained significant (adjusted odds ratio 3.07, 95% CI 1.20-7.88).

Similarly, the mean (Table 2) and median (Multimedia Appendix 3) scores of the intention to use were higher in online survey respondents (mean 4.0, median 4) than in phone survey respondents (mean 3.1, median 3).

**Facilitators and Barriers to Using the App**

A total of 84 (84%) participants responded to the facilitator question, for which we identified 73 segments (from 66 participants) that described facilitators. A total of 80 (80%) participants responded to the barrier question, for which we identified 70 segments (from 63 participants) that described barriers. The analyses of these segments identified 9 facilitators or motivations (Figure 1) and 9 barriers (Figure 2). The major facilitators included (1) easily reaching providers, (2) accessing or providing information, (3) quickly reaching providers, and (4) consulting providers for symptoms. We distinguished between barriers 1 and 3, with barrier 1 focusing on convenience...
in care access (see code definition and more example quotes in Multimedia Appendix 2). The main barriers included (1) privacy/security concerns, (2) uncomfortable using technology, (3) user-unfriendly app interface, and (4) preference for in-person/phone care.

Among participants under 65 years, 87% (33/38) mentioned facilitators to app use, with the most noticeable one being “easily reach providers” (frequency of 14). Among participants aged 65 years or older, 53% (33/62) mentioned facilitators, with the most noticeable one being “access and provide information” (frequency of 8). Among participants under 65, 55% (21/38) mentioned barriers to app use, with the most noticeable one being “lack of timely response” (frequency of 5). Among participants aged 65 years or older, 65% (40/62) mentioned barriers, with the most noticeable one being “uncomfortable with technology” (frequency of 12).

**Figure 1.** Facilitators to using a symptom monitoring app. Each segment was assigned a single code (ie, facilitator). We have provided an example quote for each code (in parallel to the bars in the figure). More example quotes are provided in Multimedia Appendix 2.
Figur 2. Barriers to using a symptom monitoring app. Each segment was assigned a single code (ie, barrier). We have provided an example quote for each code (in parallel to the bars in the figure). More example quotes are provided in Multimedia Appendix 2.

Discussion

Principal Findings

This is the first study to assess the intention to use a postdischarge symptom monitoring app in ACS patients. We found that most (65/100, 65%) ACS patients had the intention to use an app to monitor and report postdischarge symptoms to providers. Compared with other participants, those aged 75 years or older or lacking access to technology (ie, internet and smartphones) had a lower intention to use the app. Furthermore, phone survey respondents had a lower intention to use the app than online survey respondents. Open-ended survey questions identified important facilitators (Figure 1) and barriers (Figure 2) to using the app in the following 4 domains: access to care, communication, technology, and privacy.

Intention to Use Digital Symptom Monitoring in Older Patients With ACS

Although ACS patients are mostly older adults, we still found a high intention to use the symptom monitoring tool in this population. Specifically, 60% of older participants (≥65 years old) had the intention to use the app. Furthermore, the percentage of participants aged 65-74 years who had the intention to use the app (75%) was as high as that (74%) among younger participants. Our findings are compatible with previous findings on the intention to use health information technology, including symptom monitoring apps, in older adults [27,28,36-41]. For example, prior studies found that 46%-51% of participants older than 60 years would like to use a mobile app to track mental health conditions [27,28]. Other studies also found mobile symptom tracking apps acceptable for older patients with heart failure [38,39], and an app incorporating design features specific to older adults received high usability scores [39]. Similar to prior studies [27,42], we found that older participants had a lower intention to use the app, but we saw this pattern only in participants aged 75 years or older.

Lack of an Email Address in the EHR: A Potential Indicator for a Low Intention to Use Digital Symptom Monitoring

For this study, we intentionally used phone calls to recruit patients who did not have an email address in the EHR. The absence of an email address may imply a lack of email access, infrequent use of email, or less comfort with sending and receiving emails. Most of these participants (ie, those without an email address in the EHR) chose to complete the survey over the phone and had a lower intention to use a symptom monitoring app, even after adjusting for age and access to technology. This suggests that a lack of an email address itself may be a useful predictor and provide meaningful information for health care teams making decisions about remote symptom monitoring postdischarge. In the future, this information (ie, lack of an email address in the EHR) can be used to purposefully
sample key informants to help design and user test symptom monitoring apps and identify patients who may need greater training and support in app use.

**Patient-Perceived Facilitators and Barriers to Using Digital Symptom Monitoring**

This study also identified important facilitators and barriers to using a symptom monitoring app in ACS patients. Prior studies found that perceived usefulness significantly influenced the intention to use medical apps in older patients [40,41,43,44]. Similarly, we found that the facilitators or motivations to using a symptom monitoring app mainly were related to perceived usefulness of the app, such as reaching health providers easily, accessing and providing health information, and consulting with providers regarding symptom management. The major barrier identified was patients’ concerns with privacy and security. This is common with digital health interventions and needs to be addressed from the perspectives of both the app and the users [45-48]. In addition to following the regulations and incorporating standard security features in app design [47,48], it is important to assess user opinions on desired privacy and security features in their local context [46,49]. In this study, we found that ACS patients were concerned about who will access their health information and the disclosure of their health information to a third party without their knowledge and authorization. Using hospital-authorized apps, clearly communicating with patients an app’s privacy statement, and providing options for choosing which information to disclose with whom may reduce this barrier. Similar to prior studies [25,26], we found that the most notable barrier for using the symptom app in older (≥65 years old) ACS patients is being uncomfortable using technology. Patient-centered app design, in-hospital training for app use, and app use support from caregivers may help reduce the barriers [50].

Previous studies found that patients sometimes have challenges in deciding when to use an app to report symptoms. For example, patients sometimes reported urgent issues via secure messaging services designed for communicating nonurgent issues [51-53]. In addition, prior studies found that ACS patients were more stressful about certain symptoms and 15% of patients developed stress disorder symptoms after ACS [54,55]. It is likely that some patients would unnecessarily seek acute care when experiencing nonurgent symptoms [56]. In this study, we did not find these issues to be a theme when analyzing patient-reported barriers to app use. However, it is important to communicate with patients about the appropriate use of a symptom monitoring app and how frequently providers would review or respond to patient reporting. Patient education on how to assess the severity of symptoms, for example, identifying typical ACS symptoms that need urgent care, is also relevant and may improve health care utilization.

**Implications on App Design and Development**

Whether an intention to use a digital health app can translate into real use depends on many factors, such as app design and implementation strategies to support app use. In addition to general app design principles (eg, secure and easy to use), this study suggests additional considerations in app development for ACS patients. Specifically, we found that older age and lack of access to technology were associated with a low intention to use the app, and the most common barrier to app use in older adults was being uncomfortable using technology. This suggests that a multimodal strategy may be more effective in engaging these patients. For those who have nonsmart phones or are less comfortable using apps, text messaging may serve as an additional communication channel. Alternatively, app design may allow for the involvement of family members or caregivers in symptom tracking. In addition, accessible design principles for older adults may be incorporated by including a consistent and simple interface, making the most essential functionalities readily visible and available, and making it easier to “undo” an unintended action [57,58]. A co-creation approach that engages older patients in all stages of app development and user testing is also important for improving app adoption and user experience [59,60].

In this study, we also found that patients were motivated to use an app to easily reach providers. Therefore, the app should allow providers to easily access symptom reports, triage symptoms, and respond to patient symptoms and concerns. It is also critical to engage providers in all phases of app design and testing. App adoption will need to address how to integrate information from the app into the EHR, and assess the impact of the app on provider burden and clinical workflow [61,62].

**Limitations**

Our sample was relatively small and from a health care system in 1 state, and most participants were non-Hispanic White. Therefore, our findings may not be generalizable to other settings. Constrained by the format of a survey study, participants’ responses to the open-ended survey questions were typically short and lacked detailed information about the contextual factors related to the perceived facilitators and barriers. We interpret these qualitative results based on the existing literature. In-depth qualitative studies are warranted to better understand certain barriers, such as the preference for in-person care and phone communication.

**Conclusions**

We found a strong intention of using a symptom monitoring app postdischarge among ACS patients. However, this intent was lower in patients aged 75 years or older. Our survey identified barriers related to privacy and security, technology use, and the care delivery mode. Using hospital-authorized apps and in-hospital training may reduce the barriers. Further research is warranted to determine if such intent translates into app use, and better symptom management and health care quality.
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Authors' Contributions
JC and RSS conceived this study. JC designed the study with inputs from RSS, JGW, and LML. LML and GEE recruited and surveyed the participants. JC analyzed the quantitative survey data. GEE, JGW, LML, and JC coded responses to open-ended survey questions, and JC and JGW finalized the qualitative analyses. RSS, BSG, and TKH provided expertise in digital health research and critical intellectual inputs to data analysis and result interpretation. JC drafted the manuscript. JGW, GEE, LML, and BSG contributed to paper writing. RSS, BSG, and TKH provided important feedback for paper revision. All authors reviewed and provided feedback for the manuscript and approved the final manuscript.

Conflicts of Interest
None declared.

Multimedia Appendix 1
Survey to assess the intention to use a symptom monitoring app.
[DOCX File, 18 KB-Multimedia Appendix 1]

Multimedia Appendix 2
Codebook and example quotes for facilitators and barriers to using a symptom monitoring app.
[DOCX File, 28 KB-Multimedia Appendix 2]

Multimedia Appendix 3
Intention to use a symptom monitoring app, stratified by patient characteristics and the survey delivery mode.
[DOCX File, 24 KB-Multimedia Appendix 3]

References
9. Medicare Program; CY 2020 Revisions to Payment Policies Under the Physician Fee Schedule and Other Changes to Part B Payment Policies; Medicare Shared Savings Program Requirements; Medicaid Promoting Interoperability Program


**Abbreviations**

- **ACS**: acute coronary syndrome
- **EHR**: electronic health record