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Clinician Perspectives on Telemedicine: Observational Cross-sectional Study

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Abstract

Background: Since the COVID-19 pandemic onset, telemedicine has increased exponentially across numerous outpatient departments and specialties. Qualitative studies examining clinician telemedicine perspectives during the pandemic identified challenges with physical examination, workflow concerns, burnout, and reduced personal connection with patients. However, these studies only included a relatively small number of physicians or were limited to a single specialty, and few assessed perspectives on integrating trainees into workflows, an important area to address to support the clinical learning environment. As telemedicine use continues, it is necessary to understand a range of clinician perspectives.

Objective: This study aims to survey pediatric and adult medicine clinicians at the University of Chicago Medical Center to understand their telemedicine benefits and barriers, workflow impacts, and training and support needs.

Methods: In July 2020, we conducted an observational cross-sectional study of University of Chicago Medical Center faculty and advanced practice providers in the Department of Medicine (DOM) and Department of Pediatrics (DOP).

Results: The overall response rate was 39% (200/517; DOM: 135/325, 42%; DOP: 65/192, 34%); most respondents were physicians (DOM: 100/135, 74%; DOP: 51/65, 79%). One-third took longer to prepare for (65/200, 33%) and conduct (62/200, 32%) video visits compared to in-person visits. Male clinicians reported conducting a higher percentage of telemedicine visits by video than their female counterparts ($P = .02$), with no differences in the number of half-days per week providing direct outpatient care or supervising trainees. Further, clinicians who conducted a higher percentage of their telemedicine by video were less likely to feel overwhelmed ($P = .02$), with no difference in reported burnout. Female clinicians were “more overwhelmed” with video visits compared to males (41/130, 32% vs 12/64, 19%; $P = .05$). Clinicians 50 years or older were “less overwhelmed” than those younger than 50 years (30/85, 35% vs 23/113, 20%; $P = .02$). Those who received more video visit training modalities (eg, a document and webinar on technical issues) were less likely to feel overwhelmed by the conversion to video visits ($P = .007$) or burnt out ($P = .009$). In addition, those reporting a higher ability to technically navigate a video visit were also less likely to feel overwhelmed by video visits ($P = .02$) or burnt out ($P = .001$). The top telemedicine barriers were patient-related: lack of technology access, lack of skill, and reluctance. Training needs to be focused on integrating learners into workflows. Open-ended responses highlighted a need for increased support staff. Overall, more than half “enjoyed conducting video visits” (119/200, 60%) and wanted to continue using video visits in the future (150/200, 75%).

Conclusions: Despite positive telemedicine experiences, more support to facilitate video visits for patients and clinicians is needed. Further, clinicians need additional training on trainee education and integration into workflows. Further work is needed.
to better understand why gender and age differences exist. In conclusion, interventions to address clinician and patient barriers, and enhance clinician training are needed to support telemedicine’s durability.

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**KEYWORDS**

telemedicine; clinician perspective; patient-centered care; burnout; trainee; outpatient; workflow; virtual health; training; human factors

**Introduction**

Telemedicine uses electronic communications and software, like video and telephone visits, to deliver remote clinical services to patients [1]. Positive telemedicine outcomes include increased access to care, reduced wait times, improved clinical outcomes, and high patient and clinician satisfaction [2,3]. Despite this, telemedicine is generally less accepted by clinicians compared to patients [4,5], citing concerns over compensation, inadequate training, additional work, and difficulty adapting to technology [5].

Since the COVID-19 pandemic onset, telemedicine has increased exponentially across numerous outpatient departments and specialties [6,7]. Clinicians had to quickly pivot to provide substantial amounts of virtual care, resulting in the need to learn new workflows. In qualitative studies examining clinician telemedicine perspectives in the pandemic’s wake, clinicians reported challenges with physical examination, workflow concerns, burnout, and reduced personal connection with patients [8,9]. Although these studies set a baseline for understanding clinician barriers to telemedicine, they only explored perceptions of a relatively small number of physicians [8,10] or were limited to physicians from one specialty [9,11-13]. Furthermore, few studies assessed clinician perspectives on effectively integrating trainees into telemedicine workflows, an important area to address to support the clinical learning environment. As telemedicine maintains its foothold in outpatient medicine throughout and likely beyond the pandemic, it is necessary to understand a broad range of clinician perspectives on its impact on patient care, workflows, and trainee education, particularly since clinicians are more satisfied with telemedicine when they have input and support in its development [3].

Our study aims to survey pediatric and adult medicine clinicians at the University of Chicago Medical Center (UCMC) to understand perspectives on telemedicine benefits and barriers, workflow impacts, and training and support needs. Capturing clinician perceptions in various outpatient departments and specialties is critical to improving the clinician and patient telemedicine experience and to ensuring successful integration and durability of virtual encounters [14].

**Methods**

**Setting and Participants**

UCMC is a large urban academic health system and affiliated care network that provides tertiary care in the South Side of Chicago. As background, telemedicine was used for outpatient primary care at UCMC in the Department of Medicine (DOM) and Department of Pediatrics (DOP) whenever possible beginning March 15, 2020, to provide safe and socially distanced care. The total number of UCMC ambulatory visits at this time dropped substantially, with ambulatory visits falling to 23% of visit volumes when compared to the same week in the fiscal year (FY) 2019 [7]. After approximately 6 weeks, however, UCMC ambulatory visit volume had reached 92% of FY 2019 volumes, largely driven by the increase in virtual visits by nearly 1000 of our ambulatory clinicians. Overall, between March 15 and May 31, 2020, UCMC virtual visits increased from 0 to 48,475 visits; 60.5% of total ambulatory visits were virtual, of which 61.2% (n=29,661) were by video and 38.8% (n=18,814) were by telephone [7].

**Survey Development**

We developed a 54-question survey (Multimedia Appendix 1) to capture clinician perceptions and needs for telemedicine implementation. Questions were based on a literature review of the impact of telemedicine on patient and clinician satisfaction and workflows, and informed by discussions with key UCMC stakeholders and leaders, practicing clinicians, and trainees. The survey consisted of Likert-style and open-ended questions, and assessed key areas including perceptions about benefits and barriers (n=20), workflow impacts (n=5), overall satisfaction (n=4), and training or support needs (n=6). Clinicians who worked with trainees (eg, medical students, residents, or fellows) were asked about their experiences with trainee integration and education (n=7). Open-ended questions (n=4) were included to elicit suggestions not previously asked. This project received a formal Determination of Quality Improvement project status according to UCMC institutional policy and, as such, was not reviewed by an institutional review board.

**Survey Distribution**

In July 2020, 517 UCMC physicians and advanced practice providers (APPs; eg, advanced practice nurses, clinical nurse specialists, and physicians’ assistants) in the DOM (n=325) and DOP (n=192) were invited via email to participate in the survey. The email was sent by UCMC leadership and the study investigators (MAA and WWL). Data was collected and managed using REDcap (v8.9.2; Vanderbilt University) [15]. The survey was open for 6 weeks, with one reminder email at 3 weeks. Individual emails were sent to DOP and DOM chairs and section chiefs at regular intervals, notifying them of their response rate and asking them to encourage clinician participation.

**Data Analysis**

REDcap data was exported to Stata 16 (Stata Corp) [16] and RStudio (version 3.6.1; RStudio, PBC) [17] for statistical analysis. Quantitative outcomes were summarized by descriptive
statistics. Chi-square tests, Fisher exact tests, and t tests assessed differences in outcomes among groups of interest. Ordinal logistic regressions examined associations between ordinal outcomes and explanatory variables of interest. Significance was defined as a two-sided $P$ value less than .05.

Open-ended question responses were collectively pooled and read. Content analysis identified unique response themes, and representative quotations were identified to build a picture of clinicians’ collective experiences and video visit needs [18].

**Results**

**Overview**

The overall response rate was 39% (200/517; DOM: 135/325, 42%; DOP: 65/192, 34%). Respondent demographics are displayed in Table 1. The majority of respondents were faculty physicians (DOM: 100/135, 74%; DOP: 51/65, 78.5%), with roughly a quarter of APP respondents (DOM: 35/135, 26%; DOP: 14/65, 21.5%; $P$<.001). Most clinicians were aged 30 to 59 years (154/200, 77%), and 65% (130/200) were female. More female clinicians were also younger (83/130, 64% females <50 years vs 27/64, 42% males; $P$=.006). There were no significant differences by department (DOM vs DOP) or clinician age in terms of the number of half-days per week spent providing direct outpatient care, supervising trainees, or the percentage of telemedicine visits they personally conducted by video in the past week (Table 2). Although there were gender differences, with more male clinicians reporting they conducted a higher percentage of telemedicine visits by video than their female counterparts ($P$=.02), there were no significant differences in number of half-days per week spent providing direct outpatient care or supervising trainees.
Table 1. Clinician information by department.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Department of Medicine (n=135), n (%)</th>
<th>Department of Pediatrics (n=65), n (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinician position</strong></td>
<td></td>
<td></td>
<td>.77</td>
</tr>
<tr>
<td>Physician</td>
<td>100 (74.1)</td>
<td>51 (78.5)</td>
<td></td>
</tr>
<tr>
<td>Advanced practice providera</td>
<td>35 (25.9)</td>
<td>14 (21.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td></td>
<td></td>
<td>.65</td>
</tr>
<tr>
<td>20-29</td>
<td>2 (1.5)</td>
<td>0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>30-39</td>
<td>48 (35.6)</td>
<td>17 (26.2)</td>
<td></td>
</tr>
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<td>40-49</td>
<td>28 (20.7)</td>
<td>18 (27.7)</td>
<td></td>
</tr>
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<td>50-59</td>
<td>27 (20.0)</td>
<td>16 (24.6)</td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>23 (17.0)</td>
<td>11 (16.9)</td>
<td></td>
</tr>
<tr>
<td>≥70</td>
<td>6 (4.5)</td>
<td>2 (3.1)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td>.49</td>
</tr>
<tr>
<td>Female</td>
<td>85 (63.0)</td>
<td>45 (69.2)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47 (34.8)</td>
<td>17 (26.2)</td>
<td></td>
</tr>
<tr>
<td>Prefer not to say</td>
<td>3 (2.2)</td>
<td>3 (4.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Half-days per week providing direct outpatient careb</strong></td>
<td></td>
<td></td>
<td>.07</td>
</tr>
<tr>
<td>0-2</td>
<td>56 (41.5)</td>
<td>16 (24.6)</td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td>44 (32.6)</td>
<td>22 (33.8)</td>
<td></td>
</tr>
<tr>
<td>5-6</td>
<td>24 (17.8)</td>
<td>15 (23.1)</td>
<td></td>
</tr>
<tr>
<td>≥7</td>
<td>11 (8.1)</td>
<td>11 (16.9)</td>
<td></td>
</tr>
<tr>
<td><strong>Telemedicine visits personally conducted by video in the past week?b (%)</strong></td>
<td></td>
<td></td>
<td>.09</td>
</tr>
<tr>
<td>0-24</td>
<td>38 (28.1)</td>
<td>26 (40.0)</td>
<td></td>
</tr>
<tr>
<td>25-49</td>
<td>33 (24.4)</td>
<td>9 (13.8)</td>
<td></td>
</tr>
<tr>
<td>50-74</td>
<td>32 (23.7)</td>
<td>10 (15.4)</td>
<td></td>
</tr>
<tr>
<td>≥75</td>
<td>32 (23.7)</td>
<td>20 (30.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Number of half-days per week spent supervising traineesc</strong></td>
<td></td>
<td></td>
<td>.21</td>
</tr>
<tr>
<td>0</td>
<td>69 (51.1)</td>
<td>34 (52.3)</td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>51 (37.8)</td>
<td>19 (29.2)</td>
<td></td>
</tr>
<tr>
<td>≥3</td>
<td>14 (10.4)</td>
<td>12 (18.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Types of video visit training received</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Received a document on technical issues</td>
<td>83 (61.5)</td>
<td>47 (72.3)</td>
<td>.18</td>
</tr>
<tr>
<td>Webinar on technical issues</td>
<td>47 (34.8)</td>
<td>17 (26.2)</td>
<td>.29</td>
</tr>
<tr>
<td>In-person training on technical issues</td>
<td>5 (3.7)</td>
<td>3 (4.6)</td>
<td>.72</td>
</tr>
<tr>
<td>Received a document on communication strategies</td>
<td>35 (25.9)</td>
<td>24 (36.9)</td>
<td>.15</td>
</tr>
<tr>
<td>Webinar on communication strategies</td>
<td>18 (13.3)</td>
<td>9 (13.8)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>In-person training on communication strategies</td>
<td>1 (0.7)</td>
<td>2 (3.1)</td>
<td>.25</td>
</tr>
<tr>
<td>None</td>
<td>25 (18.5)</td>
<td>6 (9.2)</td>
<td>.14</td>
</tr>
<tr>
<td>Other</td>
<td>4 (3.0)</td>
<td>3 (4.6)</td>
<td>.68</td>
</tr>
</tbody>
</table>

aExamples of advanced practice providers include advanced practice nurses, clinical nurse specialists, and physicians’ assistants.

bRefers only to visits conducted personally by the clinician and not trainees they supervised.

cTrainees include medical students, residents, and fellows.
Table 2. Clinician information by age and gender.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Female (n=130), n (%)</th>
<th>Male (n=64), n (%)</th>
<th>Younger than 50 years (n=113), n (%)</th>
<th>Older than 50 years (n=85), n (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half-days per week providing direct outpatient care^a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-2</td>
<td>39 (30.0)</td>
<td>30 (46.9)</td>
<td>41 (36.3)</td>
<td>31 (36.5)</td>
<td>.35</td>
</tr>
<tr>
<td>3-4</td>
<td>44 (33.8)</td>
<td>21 (32.8)</td>
<td>38 (33.6)</td>
<td>28 (32.9)</td>
<td></td>
</tr>
<tr>
<td>5-6</td>
<td>33 (25.4)</td>
<td>5 (7.8)</td>
<td>24 (21.2)</td>
<td>14 (16.5)</td>
<td></td>
</tr>
<tr>
<td>≥7</td>
<td>14 (10.8)</td>
<td>8 (12.5)</td>
<td>10 (8.8)</td>
<td>12 (14.1)</td>
<td></td>
</tr>
<tr>
<td>Telemedicine visits personally conducted by video in the past week^a (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.02</td>
</tr>
<tr>
<td>0-24</td>
<td>47 (36.2)</td>
<td>15 (23.4)</td>
<td>39 (34.5)</td>
<td>25 (29.4)</td>
<td>.16</td>
</tr>
<tr>
<td>25-49</td>
<td>30 (23.1)</td>
<td>12 (18.8)</td>
<td>24 (21.2)</td>
<td>17 (20.0)</td>
<td></td>
</tr>
<tr>
<td>50-74</td>
<td>28 (21.5)</td>
<td>11 (17.2)</td>
<td>27 (23.9)</td>
<td>14 (16.5)</td>
<td></td>
</tr>
<tr>
<td>≥75</td>
<td>25 (19.2)</td>
<td>26 (40.6)</td>
<td>23 (20.4)</td>
<td>29 (34.1)</td>
<td></td>
</tr>
<tr>
<td>Number of half-days per week spent supervising trainees^b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.52</td>
</tr>
<tr>
<td>0</td>
<td>69 (53.1)</td>
<td>29 (45.3)</td>
<td>63 (55.8)</td>
<td>39 (45.9)</td>
<td>.45</td>
</tr>
<tr>
<td>1-2</td>
<td>43 (33.1)</td>
<td>27 (42.2)</td>
<td>35 (31.0)</td>
<td>35 (41.2)</td>
<td></td>
</tr>
<tr>
<td>≥3</td>
<td>18 (13.8)</td>
<td>8 (12.5)</td>
<td>15 (13.3)</td>
<td>11 (12.9)</td>
<td></td>
</tr>
<tr>
<td>Presence of burnout^c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.29</td>
</tr>
<tr>
<td>Yes</td>
<td>56 (43.1)</td>
<td>22 (34.4)</td>
<td>55 (48.7)</td>
<td>26 (30.6)</td>
<td>.01</td>
</tr>
<tr>
<td>No</td>
<td>74 (56.9)</td>
<td>42 (65.6)</td>
<td>58 (51.3)</td>
<td>59 (69.4)</td>
<td></td>
</tr>
<tr>
<td>Converting in-person visits to video visits has resulted in feeling...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.05</td>
</tr>
<tr>
<td>More overwhelmed</td>
<td>41 (31.5)</td>
<td>12 (18.8)</td>
<td>31 (27.4)</td>
<td>24 (28.2)</td>
<td>.02</td>
</tr>
<tr>
<td>Similarly overwhelmed</td>
<td>59 (45.4)</td>
<td>28 (43.8)</td>
<td>59 (52.2)</td>
<td>31 (36.5)</td>
<td></td>
</tr>
<tr>
<td>Less overwhelmed</td>
<td>29 (22.3)</td>
<td>24 (37.5)</td>
<td>23 (20.4)</td>
<td>30 (35.3)</td>
<td></td>
</tr>
</tbody>
</table>

^aRefers only to visits conducted personally by the clinician and not trainees they supervised.
^bTrainees include medical students, residents, and fellows.
^cAs defined by respondents own definition of burnout.

Training

Most clinicians received some video visit training on technical issues (DOM: 93/135, 69%; DOP: 51/65, 78%), and fewer received telemedicine communication practice training (DOM: 42/135, 31%; DOP: 27/65, 42%; P=.001). There were no differences in training across gender, age, or departments.

Comparison of Video Visits With In-person and Telephone Visits

Figure 1 demonstrates clinician attitudes and experiences with regard to video, telephone, and in-person visits. Although nearly half of the 200 clinicians reported video visits took a similar amount of time to prepare (n=114, 57%) and document (n=104, 52%) compared to in-person visits, nearly one-third reported video visits took longer to prepare (n=65, 33%), conduct (n=64, 32%), and document (n=49, 25%). Likewise, when comparing video visits with telephone visits, nearly half reported video visits took a similar amount of time to prepare (n=111, 56%) and document (n=111, 56%). However, one-third of clinicians reported video visits took more time to prepare (n=72, 36%), conduct (n=96, 48%), and document (n=69, 35%) than telephone visits. Although there were no differences across gender or age, DOP clinicians were more likely to report that video visits took longer to document compared to in-person visits (DOP: 25/65, 38% vs DOM: 32/135, 24%; P=.03) and telephone visits (DOP: 29/65, 45% vs DOM: 40/135, 30%; P=.04).

Despite the virtual nature of the visit, most of the 200 clinicians (n=156, 78%) felt they could promote shared decision making during video visits as well as they could in in-person visits. Half (n=105, 53%) felt they could better promote shared decision making during video visits compared to telephone visits. Just over half (n=105, 53%) felt they could personally connect as well or better with patients during video visits compared to in-person visits, with 66% (n=131) reporting they connected better with patients over video than over telephone. Although there were no differences across gender or age, DOP clinicians were more likely to report personal connection (DOM: 79/135, 59%; DOP: 52/65, 80%; P=.003), and the ability to share decisions with patients (DOM: 60/135, 44%; DOP: 46/65, 71%; P=.01) was better over video compared to telephone. DOP clinicians were also more likely to report that their ability to share decisions with patients was as good or better via video visits.
compared to in-person visits (DOM: 105/135, 78%; DOP: 60/65, 92%; \(P=.01\)).

Just over half of the 200 clinicians reported their level of distraction was similar when comparing video visits to in-person (n=110, 55%) and telephone visits (n=114, 57%). Most (n=176, 88%) felt patient trust in their diagnosis over video was similar compared to in person, whereas about half (n=104, 52%) felt patient trust over video was similar compared to telephone. Just over one-third (n=78, 39%) felt patient trust was better over video compared to telephone. Finally, nearly two-thirds agreed that being able to visualize a patient’s home environment (n=120, 60%) and being able to have patient companions join the video visit (n=168, 84%) added valuable insight into their patients’ lives. There were no differences across gender, age, or departments in these areas.

**Figure 1.** Video visit sentiments compared to in-person and telephone visits. Clinicians were asked to rate statements comparing video visits to (a) in-person visits and (b) telephone visits as “more,” “similar(ly),” or “less” in various categories (eg, “Video visits take more, similar, or less time to document compared to in-person visits”).

### Video Visit Barriers

The top three most commonly cited barriers from the 200 clinicians to conducting video visits were not clinician-specific barriers but rather patient related, including patient lack of technical knowledge (n=139, 70%), lack of patient access to necessary technology for a video visit (n=132, 66%), and patient reluctance to have a video visit (n=75, 38%; Table 3). The next most frequently cited barriers were inadequate staff support both during (n=70, 35%) and when scheduling visits (n=68, 34%). There were no differences across gender, age, or departments in visit barriers.
Faculty physicians who precepted trainees (n=96) during telehealth visits cited “concerns about integrating them into video visit workflows” and “uncertainty about documentation rules” as the top two barriers both when working with residents and fellows (n=52, 54% and n=22, 23%, respectively) and medical students (n=36, 38% and n=19, 20%, respectively; Table 3). The next most commonly cited barriers for medical educator clinicians was uncertainty about how to give trainees feedback on their virtual visit performance (residents and fellows: n=15, 16%; medical students: n=12, 13%). Overall, nearly three-quarters of teaching clinicians agreed or strongly agreed that “virtual medicine has made clinical teaching more difficult” (n=69, 72%). This sentiment was further reflected in clinicians’ open-ended responses where some (n=8) reported having little experience with and needing substantially more training to integrate medical students, residents, and fellows into virtual workflows (Textbox 1). There were no differences across gender, age, or departments in trainee barriers.
Textbox 1. Themes and representative quotations of video visit needs.

How can your section/department best support you in the use of video visits?
- Provide clinic staff support to prepare patients for visits
  - “I would like support staff dedicated to virtual visits, so they can interface with patients with expertise.”
  - “Technical support, and working with patients so they are comfortable with video visits.”
- Streamline scheduling processes and video visit workflows
  - “Video visit slots are like clinic slots; allow for enough time for the visit and documentation of the visit.”
  - “Screen the patients who benefit from the video visits, and who should have personal visits at clinic.”

How can your section/department best support your patients in the use of video visits?
- Provide technical support for patients
  - “Provide the support staff to help patients troubleshoot technical issues”
  - “Help them figure out how to access the links and help them troubleshoot so that they are ready to go at the time of their virtual appointment.”
- Provide technology access for patients
  - “Ensure they have access to adequate technology. Some patients don’t even have enough cellphone minutes.”
  - “Make them accessible via phone. Most of my patients do not have laptops/tablets and need to use their phone”

What suggestions do you have on how to successfully integrate trainee teaching into telehealth visit workflows?
- Establish learner workflows
  - “We have the trainees begin the call as they would in clinic...then call the attending and ‘present’ the patient and then both join on the call to finish the visit.”
  - “I think it would be good if the trainee and attending could somehow go into a breakout room to discuss the assessment and plan without the patient.”
- Provide teaching training for preceptors
  - “Guide preceptors on how to do this best.”
- Provide more time within telehealth teaching schedules
  - “Give preceptors more time in the schedules to account for the additional time it takes to precept a student.”

Please share additional comments, suggestions, or experiences regarding your video visit experience
- Video visit experiences have been positive, and are useful for many clinicians and patients.
  - “When patients are comfortable with the technology, video visits work very well. In addition, for the most part, patient show rates are significantly higher. I would like to have the opportunity to continue to use telehealth in the future for certain patient visits.”
  - “My patients really like the video visits, however for some frail/elderly patients, it's been both a blessing and a curse.”
- Video visit limitations and utility for certain types of appointments
  - “The inability to perform at least a halfway good physical exam will eventually severely impact patient outcomes and increase cost to the system through increased testing.”
  - “I would support continuing video visits for 1. patients who live far away and are challenged by the distance, 2. patients who have limited resources to come to clinic 3. stable patients who don't need a detailed hands-on examination 4. discussion of a serious condition, or serious decision-making.”

Clinician Experience, Burnout, and Satisfaction
In the survey, participants were asked to self-report their perceived level of burnout. Overall, 81 clinicians reported burnout, with significant differences between departments (DOP: 36/65, 56%; DOM: 45/135, 34%; P=.004) but not by gender (male: 22/64, 34%; female: 56/130, 43%; P=.29). Of note, clinicians younger than 50 years (55/113, 49%) also reported higher levels of burnout compared to those 50 years or older (26/85, 31%; P=.01). Participants were also asked whether converting in-person visits to video made them feel less, similarly, or more overwhelmed.
Overall, only 28% (n=56) of the 200 clinicians felt more overwhelmed, with nearly half of clinicians (n=90, 45%) feeling similarly and 27% (n=53) feeling less overwhelmed. Notably, a higher proportion of female clinicians (41/130, 32%) than males (12/64, 19%) reported feeling less overwhelmed (P=.05). Although there was no overall difference between clinician age and feeling more overwhelmed with video visits, clinicians 50 years or older felt significantly less overwhelmed (30/85, 35%) than those younger than 50 years (23/113, 20%; P=.02). Differences in feeling overwhelmed by video visits were not seen across departments.

With respect to training, clinicians who received a greater number of video visit training modalities (eg, a document and webinar on technical issues) were less likely to feel overwhelmed by the conversion to video visits (P=.007) or burnt out (P=.009). Those reporting a higher ability to technically navigate a video visit were also less likely to feel overwhelmed by video visits (P=.02) or burnt out (P=.001). Further, clinicians who conducted a higher percentage of their telemedicine by video were less likely to feel overwhelmed (P=.02); however, there was no difference in reported burnout. There were no gender, age, or departmental differences in training or self-reported ability. Interestingly, there were also no significant differences in feeling burnt out or overwhelmed by the switch to video visits and the number of either personal or supervising teaching attending clinic sessions per week or by the type of virtual visits their trainees had (eg, video or phone).

Overall, more than half of the 200 clinicians (n=119, 60%) enjoyed conducting video visits, and 69% (n=137) reported “the benefits of video visits outweighed the negatives.” Most wanted to continue using video visits (n=150, 75%), which was higher than the fraction of clinicians (n=85, 43%) who wanted to continue using telephone visits (P<.001). There were no differences across gender, age, or department in these areas.

**Support and Training Needs**

In terms of clinician resources for technical or clinical support during video visits, the largest percentage of the 200 respondents said they had no resource to go to when an issue (technical or process) occurred (n=73, 37%), with the next largest group citing patient service representatives (n=50, 25%) or medical assistants (n=37, 19%) as their primary support resource. The top three video visit training needs reported were guidance on performing an exam (n=97, 49%), billing (n=82, 41%), and technical aspects (n=74, 37%; Table 3). There were no significant differences across gender, age, or department in training needs.

These sentiments were reflected in the open-ended responses (n=42) in **Textbox 1**. At the departmental level, clinicians (n=14) called for improved staff support before and during video visits. Regarding patient-facing barriers, they also described the need for patient technical support (n=13), while others (n=9) reiterated the need for improved patient technology literacy and access to ensure successful virtual visits. Finally, clinicians shared additional comments regarding their video visit experience. Despite overall positive experiences, clinicians (n=13) commented on video visit challenges such as adjusting to new virtual workflows and the limitations of video visits for certain patient populations and visit types.

**Discussion**

As virtual visits continue to comprise an important and increasingly prevalent form of health care delivery, it is important to understand the clinician experience and how they perceive video and telephone visits compared to in-person visits. Most clinicians enjoyed conducting video visits and felt that the connection they had with patients was similar to in-person visits. However, it is important to note that one-third of clinicians reported video visits took longer to prepare, conduct, and document compared to in-person visits. Prior to the COVID-19 pandemic, most of our clinicians had never conducted virtual visits. The overnight conversion to telemedicine required rapid adjustments to a new technology and the creation of new workflows. Further, with in-person visits, a medical assistant often starts the visit for the clinician, documenting intake questions and administering screening tools such as depression assessments, gathering background information such as interim hospitalizations and emergency room visits, and verifying information such as their medications, preferred pharmacy, and allergies.

At the start of the transition to telemedicine, most medical assistants were not assisting clinicians with these visit duties, and the burden of that additional workload and documentation fell to clinicians. Having conducted our study, the need to provide clinician visit support in the virtual setting much like that of the in-person setting became clear. Many clinicians stated that they needed more help supporting virtual visits so that patients could be **roomed** just like in a regular visit, and the lack of external visit support may have led to increased clinician burden and therefore increased time to prepare and document virtual visits. Additionally, we found clinicians who had more video visit training and higher self-rated technical knowledge were less likely to feel overwhelmed or burnt out. The longer time needed to prepare and document virtual visits could be due to the need for more training and increased familiarity with technology. As clinicians become more comfortable with virtual visits and new clinical support is implemented, providers should be resurveyed on whether they feel that telehealth visits take more time and what, if any, training needs they continue to have.

Prior to the pandemic, electronic documentation demands on clinicians were already high with clinicians spending more than one half of their workday, nearly 6 hours, interacting with the electronic health record (EHR) during and after clinic hours, 1 to 2 hours of which was during their personal time each night [19], an activity one author aptly termed “pajama time” charting [20]. Even more worrisome is that EHR documentation burden is linked to increases in medical errors, threats to patient safety, inferior documentation quality, job attrition, and clinician burnout [21]. With telemedicine potentially adding to this out-of-visit documentation load and total visit time, it is critical for institutions to recognize that increased demands on clinician time may increase burnout and to proactively develop interventions to promote efficient telemedicine workflows and
EHR efficiency to minimize clinician burden and prioritize wellness.

Despite one-third of clinicians reporting it took longer to prepare, conduct, and document telemedicine visits, we found no significant differences in burnout or feeling overwhelmed by the conversion from in-person to video and clinicians’ personal or teaching attending workload. This may be partially due to the fact that our survey period was relatively early on in the course of the pandemic, and although data showing burnout is increasing [22], this may be due to the sustained impacts of the pandemic, and because of our survey time period, these rates may have not yet started to rise to the level that they are at now. There may also be an impact of infection risk during COVID-19 and burnout as a result of clinician anxiety and stress related to either personally contracting COVID-19 or passing it to a family member [23]. The reduced number of in-person visits at the start of the pandemic, which coincided with our study period, could have led to lower rates of burnout since working from home decreased clinician exposure risk and may have reduced infection-related stress and anxiety, thereby outweighing the potential burden of virtual visits themselves.

Further, COVID-19 significantly increased the challenges of work-life balance for clinicians with children [24]. School-aged children transitioned to remote learning, and many day cares and after-school programs closed, creating a sudden need for clinician parents to source childcare. This was a major stressor for many clinician parents, and although nonideal, telemedicine provided a way for clinicians with children to work from home. The ability to provide childcare in light of the pandemic may have led to lower rates of observed burnout.

Additionally, the finding that clinicians who had more video visit training and, perhaps consequently, a higher self-rated technical facility with video visits were less likely to feel overwhelmed or burnt out by transitioning to video visits underscores the importance of clinician familiarity and efficiency with technology as a key driver in their experience. Studies examining EHR use support this finding and suggest that enhanced education and training can improve clinician technical proficiency, self-reported efficiency, and satisfaction, which could eventually have an effect on burnout [25].

We also found that clinicians who conducted a higher percentage of their telemedicine visits by video were less overwhelmed. Although we know this variable refers to the proportion of telemedicine visits conducted by video, it is possible that these individuals also conducted a higher amount of visits by video by the time they took our survey. Perhaps this group of clinicians had become more adept at conducting video visits and therefore felt less overwhelmed moving their clinics to virtual because of their skill, as previously mentioned. However, it also may be that video visits are for some reason less stressful to conduct compared to telephone visits, perhaps because communication and assessment is easier with the added visual benefit of video. That said, further study in this area is needed.

Additionally, we saw differences between groups in regard to the burden of telemedicine and potential for subsequent burnout. For instance, women reported being more overwhelmed with video visits compared to men. This may be attributed to females conducting a lower percentage of telemedicine visits by video, which was shown to be associated with feeling overwhelmed, as previously mentioned. It is unclear why female clinicians were less likely to conduct video visits despite similar clinical and teaching workloads; however, given female clinicians were younger and thus more junior, they may have opted for fewer video and more telephone sessions. Further, prior to COVID-19, female physicians spent significantly more time on household activities and childcare than their male counterparts, which was likely exacerbated by the closing of schools, day cares, etc during the pandemic [26-28]. There is also evidence that female physicians are more likely to be in frontline clinical positions, less represented in high-level decision making roles [26] and that, overall, female physicians suffered from reduced publishing productivity during COVID-19 compared to male physicians [29]. The cognitive load of new virtual workflows along with these other pandemic-related stressors [30] may provide an explanation for the differences we found in our study between males and females.

Our study also found that older clinicians (>50 years) reported being less overwhelmed than younger clinicians with the addition of video visits to their practice, despite having a similar personal and teaching clinic workload as their younger counterparts, and that younger clinicians had higher burnout at baseline compared to older clinicians. Of note, other studies have similarly found older clinicians generally experienced greater well-being and lower levels of stress compared to younger clinicians during the pandemic [31,32]. Although we had anticipated that older clinicians would potentially be more overwhelmed with the introduction of new technologies to their practice, it may be that, in addition to the diminished childcare responsibilities previously mentioned, older clinicians have greater experience and trust in their diagnostic skill and long-standing relationships with their patient panels, allowing them to more smoothly transition their practice to a virtual setting. Conversely, younger clinicians may have higher rates of burnout due to lack of experience [31] and the need to balance childcare needs in the setting of school and day care closures. These differences underscore the need for health care organizations to understand the various stressors uniquely affecting their clinicians during the pandemic and beyond, and to invest in telemedicine support structures to reduce additional burden placed on clinicians.

Although our surveyed clinicians found they could still promote patient-centered care through virtual visits, we found notable differences between pediatric and adult medicine clinicians in these areas. In particular, pediatric clinicians found telephone visits less beneficial for connecting with and making shared decisions with their patients. Pediatric patients are often not participating verbally in the visit themselves, but rather the child’s parent or guardian; therefore, the added benefit of visually observing and connecting with the child through the camera may be more important on the pediatric side. That said, pediatric clinicians reported higher confidence compared to adult clinicians that they could share decision making with their patients over video compared to in-person visits. This reinforces the idea that, although virtual visits are still useful for pediatric
patients, video visits may allow for more patient-centered techniques compared to telephone visits.

Although clinicians recognized the need for ongoing training for themselves, the top three telemedicine barriers clinicians encountered were not clinician-centered barriers such as inadequate staff support. Instead, the top three barriers identified were their patient’s barriers: access to technology, technical literacy and knowledge, and overall reluctance toward video visits. These findings have several important implications for patient care for telemedicine to be a successful means of providing care for all patients, not only technically savvy or resource-rich patients. Our findings underscore the need to better understand and minimize potential disparities with respect to the digital divide or the gap between persons who have and do not have access to new forms of information technology [33]. An early evaluation of telemedicine visits at UCMC, where Black or African American patients completed significantly fewer video visits but more telephone visits compared to White patients [7], helps further highlight this need. At other institutions, older patients, Black and Hispanic patients, patients with Medicaid insurance, and patients who need an interpreter were also less likely to have a video visit [34,35].

This finding is particularly troubling, as telemedicine was a lifeline for many to access needed clinical care during the pandemic. Telemedicine exposed inequities related to the digital divide for many of our South Side Chicago patients, and in response to this study and the knowledge that our clinician experience and success with telemedicine was critically dependent on our patient’s ability to access and use technology, we developed patient-facing materials to help patients prepare for and navigate virtual visits, including high-tech (portal, website, videos, email) and lower-tech (text, phone calls, paper mailing) means. We have also started a qualitative study in response to understand our patients’ telemedicine experiences [36] and will use our findings to expand our outreach, identify and develop needed patient resources and interventions to enhance access to technology, and better screen for and promote eHealth literacy. To minimize the digital divide, it is critical for organizations to further explore their patients’ telehealth experiences and engage them in helping identify the barriers they face that limit their ability to successfully participate in video visits [37]. In our study, clinicians reported challenges with integrating trainees into telemedicine workflows. Many were uncertain about how to document telemedicine encounters with trainees and how to provide performance feedback. As trainees return to the outpatient setting, it is necessary to address these barriers and to help teaching clinicians define opportunities for trainee education. As new telehealth competencies from the Association of American Medical Colleges emerge [38], clinician educators should focus on how to practically integrate these lessons into learner curriculum and practice. Finally, clinicians self-identified the need for further training and guidance on performing exams on video visits and technical and billing aspects of video visits. Given that over one-third of clinicians did not have a top resource for technical or process issues that arose during video visits, it is important to promote ongoing awareness and support for our many technical resources. In response, we implemented a telemedicine curriculum for medical students, residents, and faculty focusing on helping patients navigate virtual visits while integrating patient-centered care principles and provided faculty with additional training on integrating trainees into virtual workflows in a meaningful and educational manner [39].

There are several important limitations of our study to note. First, our study is limited to one institution, situated in a largely underserved area. To increase generalizability, our survey was cross departmental, including representation from our affiliate care partners who practice in nonacademic and community-based settings. Additionally, it is possible that clinician responses were influenced by the specific telemedicine platform used at UCMC; other organizations may have different experiences based on other platforms. It is important to note, however, that our survey questions broadly targeted aspects of the clinician virtual visit experience without reference to the specific telemedicine platform used. Finally, we did not directly survey patients during this time and all identified barriers, challenges, and perceptions of telemedicine in this study are based solely on the clinician experience. This underscores the need to elicit these perceptions directly from patients to better understand their challenges and perceived benefits of telemedicine.

In conclusion, this is the first study to elicit perspectives on telemedicine from a wide range of faculty from the departments of medicine and pediatrics. Clinicians identified barriers to implementation, challenges to incorporating trainee education, and training needs that should be addressed to improve the telemedicine experience. Overall, it is encouraging that clinicians enjoy video visits and can connect with their patients similarly to in-person visits. However, it is concerning that for a third of clinicians, video visits took longer to prepare, conduct, and document. To support clinician wellness, institutions must more completely understand and support clinician needs. Regarding trainee education, training is needed to help clinician educators successfully integrate students and house staff into virtual workflows, assess learner telemedicine performance, and structure virtual clinic feedback. Most importantly, the top three barriers to successful telemedicine implementation identified by clinicians are patient barriers, highlighting the need to better understand patient perceptions toward video and telephone visits, and proactively address barriers that contribute to the digital divide. It is critical to address each of these needs to support the durability of telemedicine visits as a way to complement and augment the care patients receive in person and to ensure that both clinician and patient experiences are efficient, positive, and patient-centered.
Acknowledgments

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Conflicts of Interest

None declared.

Multimedia Appendix 1

Clinician Survey.

References


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Abbreviations

APP: advanced practice provider
DOM: Department of Medicine
DOP: Department of Pediatrics
EHR: electronic health record
FY: fiscal year
UCMC: University of Chicago Medical Center

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Implications of Age on Social Media Utilization in Health Care Practice Development: Cross-sectional Survey Study

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Abstract

Background: Medical practices, which are businesses through which one or more physicians treat patients, have likely not yet taken full advantage of the reach of social media. This study analyzed data collected using an anonymous survey to assess the potential utilization of large, established social media platforms in health care. The survey collected data from a diverse population of health care professional students, faculty, and physicians affiliated with the Texas Tech University Health Sciences Center (TTUHSC). This study provides significant, actionable data to more efficiently implement a social media strategy focused on age to help developing private practices and outpatient clinics from the perspective of those with experience in the field of medicine.

Objective: This cross-sectional, exploratory, descriptive study aims to explore the most effective strategies to use social media based on patient age to bring further success to a medical practice.

Methods: Data were gathered from an anonymous, peer-validated Qualtrics survey created by the corresponding authors based on the recommendations from a panel of experts including executive leadership at TTUHSC. The survey used a variety of question styles to measure differences between social media platforms, including frequency of use, current and future implications in medicine, and comfort in a health care setting. The sample population included students, interns, faculty, and physicians affiliated with the TTUHSC located throughout West Texas.

Results: The anonymous survey included 673 individuals from several different age groups predetermined at the beginning of the study. There were 154 respondents aged between 18 and 25 years, 171 aged between 26 and 35 years, 133 aged between 36 and 45 years, 104 aged between 46 and 55 years, and 111 aged between 56 and 89 years. The sample population also has a variety of educational achievements. The respondents were grouped based on the highest level of education attained, and this included 23.5% (n=158) of respondents who earned a high school diploma, 42% (n=283) who earned a bachelor’s degree, 17.1% (n=115) who earned a master’s degree, and 17.4% (n=117) who earned a doctorate degree.

Conclusions: As social media continues to gain momentum, efficient utilization of the available platforms can help medical practices achieve larger patient populations and deliver more personalized care. However, privacy and security concerns should be considered while using social media in health care settings. Although this study demonstrated overwhelming interest in using social media in the medical field across all age groups, adoption willingness appears to be higher in younger respondents than in older respondents. Facebook was the most widely accepted social media platform in health care settings among all age groups. Nonetheless, other social media platforms could potentially be used more effectively depending on the age range of the targeted patient population.

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KEYWORDS
social media; health care; age; medical practice development; patient acquisition; health care delivery; patient education; target patient population

Introduction

Background

Nearly half of the world’s population now uses social media (approximately 3.5 billion). According to the Pew Research Center, in 2005, only 5% of American adults used at least one of these platforms. However, by 2011, that share had risen to 50% of all Americans, and in 2019, 72% of Americans reported using one of the social media platforms [1]. Considering the rapid growth and vast use, there is no doubt that social media can be used to bring further success to the medical field. The difficulty is how to best optimize this tool among varying patient populations [2,3]. Several medical institutions and private practices now broadcast recurring podcasts, YouTube videos, and other forms of social media [4]. For example, in 2019, the Texas Tech Physicians implemented paid Facebook advertising targeting current and prospective patients in West Texas to attract interest to the physicians and improve general health care screening in the area. This initiative drove a growth of over 500% in their web-based following. However, two obstacles prevent the consistent optimization of these tools. First, the direct and indirect benefits of social media are yet to be measured. Second, the best methods to capitalize on social media for new or growing medical practices are yet to be completely explored. Having seen the success of social media use in already-established groups such as Texas Tech Physicians, it is very likely that physicians interested in attempting to open a new private medical practice would also benefit from social media implementation to establish a good reputation, especially during the early stages of the practice [5]. The information and conclusions gathered from this research could greatly benefit anyone trying to improve the patient acquisition, patient satisfaction, or overall health care delivery of a medical practice [6].

Several direct benefits of using social media in health care have been identified, including increased interactions with patients, increased information accessibility, further tailored information, improved peer, social, and emotional support, increased public health surveillance, and greater potential to influence health policy [7,8]. With the rapid development and improvement of social media platforms, these benefits are only the beginning of the potential improvements that could be made through social media utilization [9]. The questions that remain are as follows: what forms of social media would lead to the greatest success, what percentage of patients from different backgrounds would social media utilization likely benefit, and what indirect benefits could arise from proper utilization of these platforms.

Objectives

Some of the challenges of social media utilization in medical practice have already been identified as quality, reliability, confidentiality, and privacy concerns [7,10,11]. However, social media has made improvements in these areas of concern such that the current benefits may outweigh the risks [12]. Although these apprehensions with social media utilization should still be addressed in further studies, this study will focus more on the opportunities of efficient social media use in the health care setting by focusing on differences in social media utilization and preference based on age.

Methods

Study Design and Sample

This was a cross-sectional survey design, exploratory, and descriptive investigation. The Institutional Review Boards at Lubbock and Odessa approved this protocol and waived the requirement for informed consent.

The possible benefits of social media utilization were measured through data gathered from an anonymous survey evaluating different perspectives of faculty, staff, and students of all backgrounds, ages, and education levels affiliated with the Texas Tech University Health Sciences Center (TTUHSC). Thus, information such as health care discipline and campus location were not captured. The total number of complete responses analyzed was 673. These participants’ perspectives are particularly valuable, as all of those who took the survey had significant exposure to how health care systems function through their diverse experiences with TTUHSC. The TTUHSC includes the School of Medicine, School of Nursing, School of Health Professions, and School of Pharmacy spread across campuses in Lubbock, Amarillo, Dallas, El Paso, Midland, and Odessa. However, no participants outside the TTUHSC system or under the age of 18 years were included in this study. The survey measured overall social media utilization among different age groups, occupations, and education levels, along with interest in social media directed toward health care. The survey also assessed what forms of social media use would be most beneficial in facilitating the success and growth of a developing medical practice. The data collected works in conjunction with an extensive review of published literature to show the demand for social media utilization in health care, while providing a perspective from a unique population of health care faculty and students affiliated with health sciences centers in West Texas.

Respondents had 2 weeks to respond to the survey. The survey included 12 questions in a variety of formats that took 3 to 5 minutes to complete. The survey was distributed by email to an automatically generated, random list of approximately 5000 people affiliated with each TTUHSC campus. This survey was conducted by self-selection (to limit bias, respondents did not know the topic of the survey until after beginning it) and was optional, so no follow-up was carried out.

The population was chosen based on a unique and potentially valuable perspective on how social media can be implemented successfully in a health care setting from those who have had experience in the field. These data were then analyzed by age to gain insight into how opinions on social media changed based on different levels of experience in their health care careers as
well as different stages of life. The value of our data is focused on providing a more focused analysis of data based on those with experience in the health care field. We hope this additional insight will provide benefits to those attempting to implement or improve social media utilization to contribute to the development of their health care practice.

**Measures and Data Collection**

The survey assesses social media use in general as well as the current and prospective implications of social media use in health care across different platform options. The social media platforms assessed were Facebook, Instagram, Twitter, LinkedIn, and YouTube. Differences in use across social media platforms were measured by requiring respondents to choose from six options assessing use frequency. The options included I do not use this platform, I use this platform weekly, I use this platform monthly, I use this platform daily, I use this platform hourly, or I use this platform more than once per day. These responses were scaled from 0 to 5 and are presented in Table 1. The comfort level of respondents with different social media platforms being used in a health care setting was measured through comparison by asking respondents to rank the different social media platforms from most comfortable to least comfortable with each platform being used in health care. The responses were scaled from 1 to 7 and are presented in Table 2. In addition, a variety of subjective questions were included to better understand the amount of social media use and the preference of such use among respondents in a health care setting. Respondents were also asked about concerns that they may have with integrating social media into their health care experience. All collected responses were assessed in groups defined by age.

Responses were defined by age prospectively, using the internal TTUHSC data. Age ranges were based on stages of life or career: 18 to 25 years, students; 26 to 35 years, interns or early career; 36 to 45 years, rapid career advancement; 46 to 55 years, peak career attainment; and 56 to 65+ years, career maturity. Ages over 65 years were included as anyone with an active TTUHSC email would not yet be retired and continuing in the same career stage.

Age often helps distinguish patient populations of different health care practices (ie, pediatrics vs geriatrics). Aging is also a well-established risk factor for the development of multiple chronic diseases, including cardiovascular disease, stroke, cancer, osteoarthritis, and dementia [13]. Other variables, such as occupation and education, require nuanced social media strategies that are less advantageous than a strategy tailored to age groups. However, occupational and educational data-based social media strategies may benefit from further studies.

**Table 1.** Social media platform use (rated using a 0-5 scale, where 0 indicates “I do not use social media” and 5 indicates “I use the platform hourly or more than 12 times a day”) by age groups.

<table>
<thead>
<tr>
<th>Social media platform</th>
<th>18-25 years, median (IQR)</th>
<th>26-35 years, median (IQR)</th>
<th>36-45 years, median (IQR)</th>
<th>46-55 years, median (IQR)</th>
<th>56-89 years, median (IQR)</th>
<th>P value*a</th>
</tr>
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<td>2 (2-3)</td>
<td>2 (2-2)</td>
<td>2 (2-3)</td>
<td>2 (1-3)</td>
<td>.06</td>
</tr>
<tr>
<td>Instagram</td>
<td>2 (1-2)</td>
<td>2 (1-3)</td>
<td>2 (0-4)</td>
<td>2 (0-3)</td>
<td>0 (0-3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Twitter</td>
<td>1.5 (0-2)</td>
<td>0 (0-1)</td>
<td>0 (0-2)</td>
<td>0 (0-4)</td>
<td>0 (0-0.25)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>LinkedIn</td>
<td>0 (0-5)</td>
<td>0 (0-5)</td>
<td>2 (0-5)</td>
<td>3 (0-5)</td>
<td>2 (0-5)</td>
<td>.12</td>
</tr>
<tr>
<td>YouTube</td>
<td>3 (2-4.25)</td>
<td>3 (2-4)</td>
<td>4 (2-4)</td>
<td>4 (2-4)</td>
<td>4 (2-5)</td>
<td>.61</td>
</tr>
</tbody>
</table>

*aAll P values were obtained from the independent samples Kruskal-Wallis test.

**Table 2.** Social media platforms that the participants are most comfortable using (ranked from 1-7, where 1 indicates the least comfortable using and 7 indicates the most comfortable using) in a health care setting by age groups.

<table>
<thead>
<tr>
<th>Social media platform</th>
<th>18-25 years, median (IQR)</th>
<th>26-35 years, median (IQR)</th>
<th>36-45 years, median (IQR)</th>
<th>46-55 years, median (IQR)</th>
<th>56-89 years, median (IQR)</th>
<th>P value*a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facebook</td>
<td>6 (5-7)</td>
<td>6 (5-7)</td>
<td>7 (5-7)</td>
<td>6 (5-7)</td>
<td>6 (4-7)</td>
<td>.47</td>
</tr>
<tr>
<td>Instagram</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
<td>4 (3-6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Twitter</td>
<td>4 (3-5)</td>
<td>4 (3-5)</td>
<td>4 (3-5)</td>
<td>4 (2.5-5)</td>
<td>3.5 (2-4.75)</td>
<td>.02</td>
</tr>
<tr>
<td>LinkedIn</td>
<td>3 (3-5)</td>
<td>4 (3-5)</td>
<td>4 (3-5)</td>
<td>4 (3-6)</td>
<td>4.5 (3-6)</td>
<td>.009</td>
</tr>
<tr>
<td>YouTube</td>
<td>5 (4-6)</td>
<td>5 (4-6)</td>
<td>5 (3-6)</td>
<td>5 (3.5-6)</td>
<td>5 (3.25-6)</td>
<td>.02</td>
</tr>
</tbody>
</table>

*aAll P values were obtained from the independent samples Kruskal-Wallis test.

**Data Analysis**

The data were summarized using descriptive statistics such as median (IQR) and frequency (percentage) as appropriate, depending on the level of measurement of the examined variables. A chi-square test was conducted to determine statistically significant differences in categorical variables across different age groups. The Kruskal-Wallis H test was conducted to determine the statistically significant differences in ordinal level variables across different age categories. The Dunn post hoc test adjusted with Bonferroni correction was performed for pairwise comparisons. As the Kruskal-Wallis H test compares mean ranks among groups on the examined variables, the mean ranks of groups that showed statistically significant differences...
were reported in addition to the medians and IQRs. Statistical significance was set at $P<.05$. All analyses were performed using the IBM SPSS software, version 25.

Results

General Study Population Results
A total of 5000 surveys were distributed, and there were a total of 811 responses. Due to some incomplete responses, the total usable responses were 13.46% (673/5000). Data show that 72.7% (489/673) of the sample population had concerns with social media use in healthcare due to lack of privacy or communication security, whereas only 4% (27/673) showed no concerns at all.

Results of Categorical Variables Across Age Groups
Table 3 summarizes our findings from four of the most telling questions that were asked in our survey. The first of these research questions (Q8) was used to assess the current influence of healthcare professionals on social media by asking respondents whether they had ever followed a professional social media account of an independent physician or medical practice. Across all respondents, 48.4% (326/673) answered “yes,” 12.8% (86/673) answered “no, but I would like to if that was an option,” leaving only 38.8% (261/673) of respondents who had never intended to follow a health care professional. There was a statistically significant association between age groups and the above response ($\chi^2 = 82.6; P<.001$; Table 3). This difference between age groups was most apparent in respondents aged 56-89 years, of which the majority (81/111, 73%) indicated that they would generally not follow a professional social media account of an independent physician or medical practice.

The next research question (Q10) was used to gauge the utility of a doctor with an updated LinkedIn account to share his or her achievements and educational or professional history. A total of 76.4% (514/673) of respondents indicated that they would find it beneficial if their physician had a public LinkedIn account. However, as in the first question, chi-square tests of the respondents’ answers were significantly different by age ($\chi^2 = 40.2; P<.001$; Table 3).

The following question (Q11) was used to garner patient interest in following or using social media for personal medical use, such as scheduling appointments. Three responses were included, as shown in Table 3, with responses differing by the degree of interest shown in using social media for this purpose. In total, 56.3% (379/673) of respondents said that they would follow a social media page that allows them to schedule appointments and contact their nurse or doctor directly to ask questions. However, only 43.7% (294/673) of respondents preferred this over a traditional web page. As with the previous research questions, these responses also differed significantly by age ($\chi^2 = 40.2; P<.001$). Respondents aged 56-89 years were significantly different when compared with all other ages, with 59.5% (66/111) of them indicating that they would not even follow the page (Table 3).

The final question shown in Table 3 (Q12) was used to assess the degree to which social media could be used to improve the likelihood of patients scheduling recommended screening tests. The responses, based on four selections ranging from no benefit to large improvement, showed that 46.8% (315/673) of the survey population would be more likely to schedule critical screening tests after seeing an educational social media post that provides links that would allow them to schedule an appointment. As with the other questions, however, chi-square analysis ($\chi^2 = 50.1; P<.001$) revealed that these responses varied significantly by age. The likelihood decreased with increasing age of the sample population. Only 24.3% (27/111) of those aged over 55 years were more likely to schedule an appointment.
Table 3. Differences in categorical variables across categories of age groups.

<table>
<thead>
<tr>
<th>Survey questions</th>
<th>18-25 years (n=154), n (%)</th>
<th>26-35 years (n=171), n (%)</th>
<th>36-45 years (n=133), n (%)</th>
<th>46-55 years (n=104), n (%)</th>
<th>56-89 years (n=111), n (%)</th>
<th>P valuea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q8. Have you ever followed a professional (not personal) social media account of an independent physician or medical practice?</td>
<td>Yes</td>
<td>77 (50)</td>
<td>98 (57.3)</td>
<td>76 (57.1)</td>
<td>52 (50)</td>
<td>23 (20.7)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>43 (27.9)</td>
<td>52 (30.4)</td>
<td>41 (30.8)</td>
<td>44 (42.3)</td>
<td>81 (73)</td>
</tr>
<tr>
<td></td>
<td>No, but I would like to if that was an option</td>
<td>34 (22.1)</td>
<td>21 (12.3)</td>
<td>16 (12)</td>
<td>8 (7.7)</td>
<td>7 (6.3)</td>
</tr>
<tr>
<td>Q10. Would you find it beneficial from a patient’s perspective for your doctor to have an updated, public LinkedIn account that would allow you to have more access to his or her professional history, achievements, and education?</td>
<td>Yes, this would help me develop confidence in my physician and add credibility to the guidance he or she gives me</td>
<td>71 (46.1)</td>
<td>86 (50.3)</td>
<td>62 (46.6)</td>
<td>44 (42.3)</td>
<td>44 (39.6)</td>
</tr>
<tr>
<td></td>
<td>Yes, but probably would not check it anyway</td>
<td>68 (44.2)</td>
<td>46 (26.9)</td>
<td>40 (30.1)</td>
<td>28 (26.9)</td>
<td>25 (22.5)</td>
</tr>
<tr>
<td></td>
<td>No, I do not think that would be useful or beneficial</td>
<td>15 (9.7)</td>
<td>39 (22.8)</td>
<td>31 (23.3)</td>
<td>32 (30.8)</td>
<td>42 (37.8)</td>
</tr>
<tr>
<td>Q11. As a patient would you be inclined to follow and use a social media page (Instagram, Facebook, etc) to contact your nurse or doctor directly to get medical questions answered, schedule appointments, and get updates? Would this be more convenient than using a conventional web page?</td>
<td>Absolutely, this would be convenient</td>
<td>58 (37.7)</td>
<td>62 (36.3)</td>
<td>52 (39.1)</td>
<td>34 (32.7)</td>
<td>27 (24.3)</td>
</tr>
<tr>
<td></td>
<td>I would follow the social media account but probably never take advantage</td>
<td>40 (25.9)</td>
<td>42 (24.5)</td>
<td>22 (16.5)</td>
<td>24 (23.1)</td>
<td>18 (16.2)</td>
</tr>
<tr>
<td></td>
<td>I would not be interested in the social media account and would just use a regular website for the information I need</td>
<td>56 (36.3)</td>
<td>67 (39.2)</td>
<td>59 (44.4)</td>
<td>46 (44.2)</td>
<td>66 (59.5)</td>
</tr>
<tr>
<td>Q12. Would you be more likely to schedule critical screening tests such as mammograms or colonoscopies if you saw an educational post on social media explaining the importance of them and providing a convenient link that would allow you to directly schedule an appointment?</td>
<td>Yes, this would help me remember to get important preventive testing</td>
<td>86 (55.9)</td>
<td>90 (52.6)</td>
<td>64 (48.1)</td>
<td>48 (46.2)</td>
<td>27 (24.3)</td>
</tr>
<tr>
<td></td>
<td>This would be beneficial and educational, but I probably would not be inclined to schedule an appointment through the post</td>
<td>51 (33.1)</td>
<td>49 (28.7)</td>
<td>36 (27.1)</td>
<td>33 (31.7)</td>
<td>37 (33.3)</td>
</tr>
<tr>
<td></td>
<td>If I saw the post, I would not pay much attention to it</td>
<td>10 (6.5)</td>
<td>16 (9.4)</td>
<td>16 (12)</td>
<td>4 (3.8)</td>
<td>17 (15.3)</td>
</tr>
<tr>
<td></td>
<td>This would not benefit me</td>
<td>7 (4.5)</td>
<td>16 (9.4)</td>
<td>17 (12.8)</td>
<td>19 (18.3)</td>
<td>30 (27)</td>
</tr>
</tbody>
</table>

aAll the P values are obtained from the Pearson chi-square test.

Social Media Use by Age

The Kruskal-Wallis test was conducted to determine the differences in social media platform use (rated using a 0-5 scale, where 0 indicates I do not use social media and 5 indicates I use the platform hourly more than 12 times a day) across different age groups. Statistically significant differences were found among different-aged Instagram users ($P<.001$) and Twitter users ($P<.001$; Table 1). Post hoc tests for use of Instagram revealed that the use differed significantly between the age groups 56-89 years (median 0, IQR 0-3) and 18-25 years (median 2, IQR 1-2; mean ranks, respectively, 255-319; $P=.16$), 56-89 years (median 0, IQR 0-2.5) and 46-55 years (median 0, IQR 0-4; mean ranks, respectively, 255-322; $P=.03$), 26-35 years (median 0, IQR 0-4; mean ranks, respectively, 257-318; $P=.02$), 26-35 years (median 0, IQR 0-1) and 18-25 years (median 1.5, IQR 0-2; mean ranks, respectively, 257-322; $P=.009$), and 36-45 years (median 0, IQR 0-1) and 18-25 years (median 1.5, IQR 0-2; mean ranks, respectively, 258-319; $P=.04$), but the use did not differ between any other age group combination. As for the use of Twitter, the post hoc test showed that there was a significant difference between age groups 56-89 years (median 0, IQR 0-2.5) and 18-25 years (median 1.5, IQR 0-2; mean ranks, respectively, 255-319; $P=.16$), 56-89 years (median 0, IQR 0-2.5) and 46-55 years (median 0, IQR 0-4; mean ranks, respectively, 255-322; $P=.03$), 26-35 years (median 0, IQR 0-1) and 18-25 years (median 1.5, IQR 0-2; mean ranks, respectively, 257-318; $P=.02$), 26-35 years (median 0, IQR 0-1) and 46-55 years (median 0, IQR 0-4; mean ranks, respectively, 257-322; $P=.03$), and 36-45 years (median 0, IQR 0-1) and 18-25 years (median 1.5, IQR 0-2; mean ranks, respectively, 258-319; $P=.04$), but the use did not differ between any other age group combination.

Of the survey population, 76.8% (517/673) claimed to follow a form of social media that regularly posts something educational related to the medical field. Facebook was the most frequently used social media platform and was considered most acceptable for use in a health care setting across all ages.
surveyed. A total of 58.8% (396/673) of the sample population checked Facebook multiple times a day, and the use varied with each social media platform (Multimedia Appendix 1).

**Social Media Comfort in Health Care by Age**

The Kruskal-Wallis test was also conducted to determine the significant differences in social media platforms that the participants are most comfortable using (ranked from 1-7, where 1 indicates the least comfortable using and 7 indicates the most comfortable using) in a health care setting that differed by age groups. Across various categories of age, except for Facebook, the participants’ responses varied significantly by age group for Instagram (P<.001), Twitter (P=.02), LinkedIn (P=.009), and YouTube (P=.02) in a health care setting (Table 2). A post hoc test showed that there was a statistically significant difference in Instagram use in a health care setting between age groups 56-89 years (median 4, IQR 3-6) and 18-25 years (median 5, IQR 4-6; mean ranks, respectively, 253-346; P=.001) and between age groups 46-55 years (median 5, IQR 4-6) and 18-25 years (median 5, IQR 4-6; mean ranks, respectively, 270-346; P=.008), but the use did not differ between any other age group combination. As for comfort using Twitter, the post hoc analysis revealed a statistically significant difference between age groups 56-89 years (median 3.5, IQR 2-4.7) and 18-25 years (median 4, IQR 3-5; mean ranks, respectively, 259-332; P=.02), but the use did not differ between any other age group combination. For LinkedIn, there was a statistically significant difference between age groups 56-89 years (median 4.5, IQR 3-6) and 18-25 years (median 3, IQR 3-5; mean ranks, respectively, 334-261; P=.02) and age groups 46-55 years (median 4, IQR 3-6) and 18-25 years (median 3, IQR 3-5; mean ranks, respectively, 325-260; P=.04), but the use did not differ between any other age group combination. Finally, for YouTube, the post hoc test revealed a statistically significant difference between age groups 36-45 years (median 5, IQR 3-6) and 26-35 years (median 5, IQR 4-6; mean ranks, respectively, 262-333; P=.006), but the use did not differ between any other age group combination.

**Discussion**

**Principal Findings**

The growing interest and influence of social media in the general public undoubtedly poses the following question [1]: why is this not being more heavily used in health care? The current explanation is that the apprehensions toward social media stem from quality, reliability, confidentiality, and privacy concerns [7]. More specifically, the most common contributors to individual and institutional fear against the use of social media in medicine and health care may include the potential violation of ethical standards, patient privacy, confidentiality, and the misrepresentation of information. According to our survey, the greatest concerns were lack of privacy (258/673, 38.3%) and communication security (231/673, 34.3%). Despite these concerns, a strong social media presence can be used to fortify a positive reputation as a medical practice. It can also be an effective way to educate the followers on important medical topics, which in turn could lead to further patient acquisition. Along with educating patients, another possible improvement to a developing medical practice is increased patient satisfaction through possibilities such as improved patient adherence [14]. The possible implications of efficient utilization of social media will continue to grow over time, but many developing medical practices that have not yet started to take advantage of these opportunities are possibly missing out on significant improvements in several areas.

Despite the concerns expressed with social media use in the medical field, the vast majority of respondents showed strong interest in greater social media involvement in health care. The results were relatively consistent between respondents aged 18-55 years, but those aged over 55 years appear to express a change in outlook on social media involvement in health care. The majority of the data’s significant findings were from the abrupt change in the opinion of the older respondents. The trend showed a steady decrease in the interest of social media utilization in health care, as each age group increased until a steep drop was found after 55 years of age (Table 3). For example, about 46.8% (315/673) of respondents indicated that they would be more likely to schedule critical screening tests after seeing an educational social media post that provides a link that would allow them to schedule an appointment. However, the likelihood decreased with increasing age of the sample population, and less than 24.3% (27/111) of those aged over 55 years were more likely to schedule an appointment (Table 3; P<.001). Another finding separating the opinion of those aged over 55 years was when asked if respondents followed a professional (not personal) social media account of an independent physician or medical practice. About 48.4% (326/673) of the respondents indicated that they did. However, when analyzed by age, the majority (81/111, 73.2%) of respondents aged 56-89 years indicated that they would not follow a professional social media account of an independent physician or medical practice (Table 3; P<.001). Finally, 56.3% (379/673) of respondents indicated that they would follow a social media page that allows them to schedule appointments and contact their nurse or doctor directly to ask a question. However, only 43.7% (294/673) of respondents would prefer this over a traditional web page, and respondents aged 56-89 years were significantly different from the other groups, with 59.5% (66/111) indicating that they would not even follow the page (P=.009; Table 3). The majority of respondents within all age groups expressed that it would be beneficial from a patient’s perspective to have a doctor with a public, updated LinkedIn account, allowing more details on their professional history. However, this was expressed more conclusively among younger respondents aged between 18 and 25 years (71/154, 46.1%) than among older respondents aged between 56 and 89 years (44/111, 39.6%; Table 3).

It could be valuable to consider how often each platform is being checked and by what demographic. Although it is likely that health care providers are more prone to follow social media regarding education in health care, these data still provide value because they show that the majority of health care professionals of all ages (the survey population had a relatively even distribution of ages) find value in social media. The data also allow us to further analyze which social media platforms are
preferred for medical-related content by health care professionals of different age groups.

Facebook and Instagram are the platforms most often checked multiple times a day, where YouTube appears to be a weekly habit and LinkedIn monthly. The majority of respondents did not use Twitter, but those that used Twitter checked it frequently (Multimedia Appendix 1). The survey data measured which social media platforms could be most successful in a health care setting by comparing differences in use and comfort in a health care setting among different age groups. Facebook was the most frequently used social media platform and was considered most acceptable for use in a health care setting across all ages (Multimedia Appendix 1). However, statistically significant differences in age groups were found between respondents’ use of both Instagram and Twitter. There were no significant differences between the 18 to 55 years age group, but the 56 to 89 years age group used Instagram significantly less than each of the other age groups (Table 1). The 56-89 years age group recorded a median of 0, meaning no use at all, whereas all other age groups reported significantly different use. The 18 to 25 years ($P<.03$), 26 to 35 years ($P<.001$), 36 to 45 years ($P=.001$), and 46 to 55 years ($P=.02$) age groups all recorded a median of 2, indicating almost daily use. Twitter also showed a similar variation in use by age. The 56 to 89 years age group reported infrequent to no use of Twitter at all, with a median of 0, which was significantly less than the 18 to 25 years age group that reported monthly to weekly use (median 1.5; $P=.16$). Twitter showed that the 46 to 55 years age group also differed significantly, with more frequent use than the 56 to 89 years age group ($P=.03$). However, the 46 to 55 years age group recorded a significantly less frequent use of Twitter when compared with the 26 to 35 years age group ($P=.009$; Table 1). Clearly, certain social media platforms such as Instagram and Twitter are more favorably adopted among younger populations. Understanding these differences could be vital to the implementation of successful and efficient strategies to use social media in a developing health care practice.

Considering the reservations to increased social media in the medical field that have been expressed, understanding the different levels of comfort for each social media platform in a health care setting could have a significant impact on the success of social media utilization. Levels of comfort among different social media platforms showed similar significant differences between age groups. The 56 to 89 years age group expressed significantly less comfort with the utilization of Instagram in health care (median 4) when compared with the 18 to 25 years age group (median 2; $P=.001$). The 46 to 55 years age group also recorded less comfort with Instagram in health care when compared with the 18 to 25 years age group ($P=.008$; Table 2). It is important to consider this decrease in comfort with increasing age for any social media utilization plan involving Instagram in health care. Twitter also showed a significant difference in comfort level using the platform in a health care setting when comparing the 56 to 89 years age group with the 18 to 25 years age group. The older populations (aged 56-89 years) showed significantly less comfort with Twitter’s use in health care (median 3.5) compared with those aged 18 to 25 years (median 4; $P=.02$; Table 2). As such, these platforms may be less useful for physicians in geriatric care than those in specialties with younger patients. For example, pediatric practices may benefit from these platforms, as the appointments are generally scheduled by parents that may fall in surveyed ages between 18 and 46 years. Interestingly, not all social media platforms showed decreased comfort with utilization in the health care setting in the older age groups. LinkedIn actually followed the opposite trend. The 56 to 89 years age group showed significantly more comfort with LinkedIn utilization in the health care setting (median 4.5) when compared with the 18 to 25 years age group (median 3; $P=.02$). The 46 to 55 years age group also showed significantly more comfort with LinkedIn in a health care setting (median 4) when compared with the 18 to 25 years age group (median 3; $P=.04$). These data show that LinkedIn could be a valuable tool for a medical practice wanting to appeal to an older patient population when implementing a social media utilization plan.

With these data in mind, it is reasonable to conclude that younger respondents tend to be more active and comfortable on social media, so the platforms they most commonly use will be checked on a more frequent basis. This should be considered when targeting specific demographics for educational videos or patient acquisition. For example, two platforms that were not included in the survey data that serve younger demographics are Snapchat and TikTok. Snapchat is most frequently used by people aged between 13 and 29 years, with 69% of 13- to 17-year-olds using the app and 62% of 18- to 29-year-olds using the app. Snapchat reached 210 million daily users in the fourth quarter of 2019. For this reason, Snapchat may not be the best option for health care–related use and was not included in the survey, but it would be worth considering in the future if it retains its current user base. The platform TikTok gained significant popularity after beginning this research and was not included in the survey data. However, it has since become a major platform with rapid growth and could be a strong tool in a future health care social media program. Although more data would need to be collected on its effectiveness in the health care setting, TikTok may be a strong option because its 800 million active users spend an average of 52 minutes per day on the app worldwide. Only 41% of the users were aged between 16 and 24 years, so there are many over the age of 25 years. The higher the active user base, the more likely a health care practice will be able to reach or target specific patient populations. Different social media platforms may be used in different ways to accomplish their objectives, but the intrinsic value of social media is the ability to reach a larger and diverse audience.

If a health care organization was trying to improve patient acquisition or reach a broader audience, the survey data suggest that optimization of social media programs requires consideration of patient demographics, especially targeting the platform type and time and use of each platform based on age. The styles of social media utilization with the first and second most interest among survey respondents were posts that address important medical topics each month with short weekly educational videos from a physician specializing in that particular area and live social media question and answer sessions, respectively. Despite the overwhelming amount of data suggesting that social media could be an excellent resource...
in the health care industry, some data indicate that there are significant concerns that may prevent efficient adoption. The majority of respondents across all age groups reported that they would not take advantage of a social media page that facilitated direct communication to receive answers to medical questions, schedule appointments, or receive general updates (Table 3). Further research is needed to better understand the possible impact of the concerns related to privacy and security of communication on the ease of general patient adoption of social media in the health care industry. Those interested in more generalizable demographics could repeat this survey with a larger sample population, including people with occupations in a variety of industries across various geographic locations in the United States. This could provide valuable insights into the most effective social media utilization in health care for different target populations. Although the future applications and growth in popularity of patients using social media to seek out medical guidance are currently unknown, the data from this survey and other available data suggest that social media utilization has room to grow and may play a more prominent role in health care. The younger generations who spend significant amounts of time each day on social media will eventually be responsible for the majority of health care spending, which could allow social media to be a powerful tool for many medical practices in the future.

Limitations and Future Research
This study included participants with higher education and experience in the Texas health care industry; however, this presents limitations due to the lack of geographical location and occupational diversity among all respondents. Further studies would benefit from including more respondents who are not affiliated with the health care system and respondents from a broader geographical distribution to improve generalizability and further understand how the public would react to increased social media utilization in the medical field. Furthermore, the survey was optional and was sent to anyone with a ttuhsc.edu email. Although this enabled a large sample size, this study design allows for self-selection, which may create a bias in the responses.

Although some challenges of health care utilization have already been identified, it would be helpful to expand on these challenges in further studies, especially addressing misinformation spread through social media in the health care field. In addition, an attempt to understand the higher use preference of LinkedIn by older age groups could help shed more light on this reverse trend compared with other social media platforms, and we recommend this as an area of future study.

Conclusions
As social media continues to grow, efficient utilization of the available platforms can help a medical practice reach out to a broader population and deliver personalized care. Although the data collected in this study demonstrated an overwhelming interest in using social media in the medical field across all age groups, adoption willingness appears to be higher in younger respondents than in older respondents. Facebook is the most widely accepted social media platform for health care applications. However, other social media platforms, such as Instagram, may be better tools for targeting younger generations. Medical practices should use social media pages to present content that is timely, relevant, and written in a clear language familiar to the target audience.

Furthermore, physicians are encouraged to have updated LinkedIn profiles to gain the attention of more potential patients and to increase patients’ confidence in their physicians. Respondents aged over 55 years seem to be less receptive to following health care–related social media pages and are particularly less receptive to using social media over a traditional web page. However, based on the majority of survey responses, there is great interest in the availability of educational health care videos on social media, access to health care providers, and appointment scheduling via hyperlinks. It is plausible that using social media in these ways could lead a medical practice to an increase in patient acquisition and improved health care delivery. There are significant concerns related to information accuracy, privacy, and security that need to be addressed to improve outcomes from social media use in the medical field. However, the current benefits and future possibilities of social media utilization make it a powerful and strategic option for medical practices to adopt.

Recommendations
On the basis of our data, we recommend that all physicians have an updated LinkedIn account, which could improve the patient-physician relationship as well as ensure patients’ confidence in their physician, among all patients aged over 18 years (Table 3; Figure 1).

Growing medical practices that are implementing a social media utilization plan should focus on patient age when targeting different patient populations. Stratifying by patient age showed more significant associations in our data and is likely more accessible information than factors such as occupation and education when implementing a social media outreach plan in a health care setting. As all age groups were more comfortable with Facebook in a health care setting and checked Facebook most frequently (Multimedia Appendix 1; Figure 1), it would likely be the most effective platform when targeting patient populations with a broad age range (18-89 years). Facebook supplemented with LinkedIn could be more effective when targeting patient populations aged over 46 years. Instagram along with Facebook could be effective in targeting patients aged under 46 years. As most medical practices have patients of all ages, our research supports a multifaceted approach that includes multiple social media platforms uniquely used to target different age groups (Figure 1).
Figure 1. Recommendations for social media strategies in health care based on age.

<table>
<thead>
<tr>
<th>Social Media Platform</th>
<th>Age</th>
<th>Recommendation</th>
</tr>
</thead>
</table>
| Facebook              | 18-46 | ✓ Social Media post  
|                       |       | ✓ Create Facebook Page  
|                       |       | ✓ Schedule Appointments via Facebook  
|                       | > 55 | × Social Media Post  
|                       |       | ✓ Create Facebook Page  
|                       |       | × Schedule Appointments via Facebook  
| Instagram             | 18-46 | ✓ Social Media post  
|                       |       | ✓ Create Facebook Page  
|                       |       | ✓ Schedule Appointments via Facebook  
|                       | > 55 | × Social Media Post  
|                       |       | ✓ Create Facebook Page  
|                       |       | × Schedule Appointments via Facebook  
| LinkedIn              | 18-46 | ✓ Create LinkedIn Professional page  
|                       | > 55 | ✓ Create LinkedIn Professional page  
| Twitter               | ALL | × While those who use Twitter check it frequently, this tool is not highly favored for medical information across all age groups surveyed |

Acknowledgments

This study required help from the TTUHSC Clinical Research Center to help with data collection, interpretation, and research protocol. The authors acknowledge and thank the following people for their efforts: Cathy Lovett, Tom Tenner, and Rohali Keesari.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Current usage of social media among different age groups.

References


Abbreviations

TTUHSC: Texas Tech University Health Sciences Center

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Factors Affecting Portal Usage Among Chronically Ill Patients During the COVID-19 Pandemic in the Netherlands: Cross-sectional Study

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Abstract

Background: The COVID-19 pandemic has impacted the capacity of the regular health care system, which is reflected in limited access to nonurgent care for patients who are chronically ill in the Dutch health care system. Nevertheless, many of them still depend on health care assistance to manage their illnesses. Patient portals are used to provide continued health care (remotely) and offer self-management tools during COVID-19 and potentially after. However, little is known about the factors influencing portal use and users’ satisfaction among patients who are chronically ill during the COVID-19 pandemic.

Objective: This study aims to examine predictors of patient portal use among patients who are chronically ill, the willingness to recommend the portal to others, and the likelihood of future use among portal nonusers.

Methods: An online self-administered questionnaire was distributed among patients who are chronically ill via social media in May 2020. The questionnaire consisted of four parts: (1) demographics including age and hours of daily internet use; (2) physical health status including COVID-19 infection, perceived level of control, and hospital visits; (3) mental health status including depression and life satisfaction; and (4) portal use including response waiting time and awareness. Descriptive, correlation, univariate, and multivariate analyses were conducted to identify factors that affect portal use, users’ willingness to recommend, and nonusers’ likelihood of future portal use.

Results: A total of 652 patients responded, and 461 valid questionnaires were included. Among the 461 patients, 67% (n=307) were identified as patient portal users. Of the nonusers, 55% (85/154) reported not being aware of the existence of a patient portal at their hospital. Significant predictors of portal use include level of control (P=.04), hospital visit time (P=.03), depression scale (P=.03), and status of life satisfaction (P=.02). Among portal users, waiting time to get a response via the portal (P<.001) and maximum acceptable waiting time (P<.001) were the strongest predictors for willingness to recommend the portal; among nonusers, the model predicted that those who were not aware of patient portals (P<.001) and were willing to wait moderately long (P<.001) were most likely to use the portal in the future.

Conclusions: This study provides insights into factors that influence portal use and willingness to recommend, based on which health care providers can improve the adoption of patient portals and their services. It suggests that health care providers should leverage efficient operations management to improve responsiveness and reduce waiting time to enhance user satisfaction and willingness to recommend use. Health care organizations need to increase portal awareness among nonusers and train their patients to increase both use and longer adoption of patient portals. Factors including depression and life satisfaction can influence portal use; therefore, future studies on determinants of portal use and nonuse in this specific population are needed.

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Introduction

On January 30, 2020, COVID-19 was officially declared a pandemic by the World Health Organization [1]. As a result of the virus outbreak, the Netherlands, along with other countries, announced a lockdown. This lockdown, called an intelligent lockdown, entailed that people were encouraged (not forced) to stay inside as much as possible, social gatherings with more than three people were prohibited, and many (nonessential) businesses were temporarily closed [2]. The primary purpose of this intelligent lockdown was to prevent peak loads of patients requiring intensive care [3]. The pandemic’s consequences were a massive burden on the Dutch health care system, particularly in the initial period of the outbreak (March 2020). Intensive care units were struggling with allocating their capacity, causing patients to be distributed over various hospitals throughout the Netherlands [4]. Meanwhile, regular health care was disrupted due to the COVID-19 outbreak. To alleviate the pressure of health care professionals and to prevent them and nonurgent patients from infecting each other [5], nonurgent patients’ appointments were canceled, postponed, or moved online [6,7]. Several experts and health care professionals subsequently proposed eHealth as a solution for the continuation of care for patients who are chronically ill [8,9].

According to a study supported by the Dutch government, approximately 5.3 million Dutch patients have one or more chronic illnesses. This number is expected to rise to 7 million by 2030 [10]. In Europe, about 70% to 80% of the total health care budget is spent on treating and preventing chronic disease [11], which indicates that chronic illness is a common issue with an enormous financial burden. Two critical elements of chronic care are frequent contact with their care providers and self-management (eg, adapting to their condition and learning to deal with their disease) [12]. Therefore, some still rely on regular nonurgent health care and need assistance during the COVID-19 pandemic to keep their illness under control. Limited access to care, in addition to the fear of contracting the virus, getting sick, or even passing away, could potentially lead to diminished (perceived) physical and mental health outcomes for this group of patients [13,14]. Indeed, previous studies have shown that people with chronic diseases are more prone to anxiety and depression than those without [15,16]. Although care for patients with COVID-19 requires the most attention during this crisis, it is crucial to continue to provide patients who are chronically ill the care they need, including offering self-management tools, monitoring, controlling, and disease treatment. It will ultimately reduce the risk of emergency care and hospital admission, and prevent long-term complications in these patients [17].

During the COVID-19 pandemic, eHealth has been suggested as a valuable solution to provide care to patients who are chronically ill, enabling self-management of chronic conditions and providing care remotely and safely [18,19]. The Dutch government has compiled a subsidy program (VIPP) to accelerate the implementation of eHealth solutions in specialized medical care organizations throughout the country [20]. By 2019, 60 out of 73 Dutch hospitals offered an eHealth solution [21]. The solution is essentially a platform called a patient portal. In these patient portals, patients are, among other things, able to investigate their electronic health records, directly message their health care practitioner, and view their laboratory results along with personal details. Each hospital was allowed to decide on the functionalities implemented in its patient portal. Despite the VIPP implementation, several reports provide evidence on the lack of patient engagement, reflected in a large portion of nonusers [22].

Therefore, it is crucial to understand which factors influence portal use for patients who are chronically ill, users’ satisfaction, and nonusers’ likelihood of future use to promote the adoption of patient portals and retain current users. A retrospective cohort study among the adult patient population found that those who are younger, are White, have commercial insurance, and have higher annual income are more likely to be portal users [23]. Another cross-sectional survey also found that age and income are significant predictors of portal adoption [24]. A cross-sectional survey among adult patients of a university hospital revealed that being chronically ill and having higher eHealth literacy were the best predictors for portal use [22]. However, it remains unknown which factors influence portal use among the patient group of interest—patients who are chronically ill—and, in particular, whether and how perceived physical and mental health conditions play a role during the COVID-19 pandemic. Besides, several papers published after the outbreak of COVID-19 studied patient satisfaction on patient portals or telehealth [25]. However, those studies are mainly descriptive (ie, they survey how many patients are satisfied with their experience rather than predicting or investigating the causal relationship). This study contributes to understanding which factors predicted portal use, portal users’ satisfaction, and portal nonusers’ likelihood of future adoption among patients who are chronically ill during the COVID-19 pandemic.

The research questions of this study are what factors affect patient portal use among patients who are chronically ill during the COVID-19 pandemic in the Netherlands and what factors affect portal users’ willingness to recommend and nonusers’ likelihood of using patient portals during the COVID-19 pandemic in the Netherlands?

Methods

Study Design and Procedure

A cross-sectional study was designed using an online self-administered questionnaire (the survey is available upon request). The survey was written in English and then translated into Dutch and verified by a person proficient in Dutch. The questionnaire was distributed throughout several Facebook groups aimed at (peer) support and providing information for patients who are chronically ill in May 2020.

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KEYWORDS

COVID-19; pandemic; digital technology; eHealth; patient portals; chronically ill patients; portal responsiveness; portal awareness
After displaying the introduction of the questionnaire, informed consent was obtained electronically, before actual enrollment. It was explicitly stated that participation was voluntary, and participants could withdraw at any time without any consequences. Moreover, complete anonymity of the response was ensured.

During the period of data collection, the number of Dutch people who tested positive for COVID-19 exceeded 40,000, over 11,000 people were hospitalized, and almost 6000 deaths related to COVID-19 had been reported in a population of 17 million inhabitants [26]. When distributing the questionnaire, the national intelligent lockdown had been active for approximately 1.5 months. As compensation for the time spent on the survey, online gift codes were distributed through a raffle. To ensure good quality responses, some survey items were programmed to be restricted in range so that incorrect inputs were not allowed.

This study followed the Institutional Review Board (IRB) for the Protection of Human Subjects Guidelines. All procedures in this study were approved by the IRB (2020/04/24-61392qko) prior to its initiation.

Participants

Since the study focused on patient portals as implemented by Dutch hospitals, the targeted population for our study was patients who are chronically ill and residing in the Netherlands. Inclusion criteria were as follows: patients aged between 18 and 65 years, having at least one chronic illness, and having spent more than 2 minutes completing the questionnaire. Questionnaires that were not completed were removed from the final data set.

Measures

**Demographic Characteristics**

Demographic variables included participant’s gender (male, female, or other), age, highest educational level completed, main occupation, yearly income, chronic illness or illnesses, hours of daily internet use, and portal use (yes or no).

**Physical Health Status and Hospital Visits**

Physical health status was assessed using four categories: (1) COVID-19 status, (2) level of control over chronic illness, (3) lifestyle and exercise, and (4) perceived health. COVID-19 status was assessed by inquiring about the prevalence of any COVID-19 symptoms over the last 2 weeks (yes, no, or unsure), COVID-19 testing (yes or no), and COVID-19 infection (yes, no, or unsure). Level of control over chronic illness was assessed using a single 5-point item, asking people to rate their current level of control over their chronic illness (totally in control to not at all in control). Lifestyle was assessed using a common measure of lifestyle and activity [27,28]. Exercise was measured by the frequency of exercise in the last 2 weeks. Perceived health was measured using the Self-Rated Health measure, a widely used, single-item measure of self-perceived health status [29]. The item consisted of one question (“In general, would you say your health is:”) with five answer options between 1 (excellent) and 5 (poor) [30]. Finally, patients’ frequency of hospital visits and their durations were also measured.

**Mental Health**

Mental health was assessed using questions about both depression severity and life satisfaction. Depression severity was measured using the Patient Health Questionnaire 9 assessment scale, which is generally used to aid clinicians in diagnosing, monitoring, and treating depressive symptoms and their severity [31]. Patients score nine different items on a scale of 0 (not at all) to 3 (nearly every day). The scores are then summed up to achieve a final score, which can be assessed by the clinician or researcher over a few cut-off categories. The categories are 0 to 4, 5 to 9, 10 to 14, 15 to 19, and 20 to 27, in sequence of increasing depression severity [32]. General well-being was assessed by examining participants’ satisfaction with life, using the Satisfaction with Life Scale [33]. The tool allows participants to self-report their opinions regarding the satisfaction they experience with their own lives. The scale contains five items, and participants report their answers over a 7-point Likert scale (1, strongly disagree, to 7, strongly agree). After the assessment, scores are summed up to arrive at a final score. The outcomes are categorized as 5 to 9 (extremely dissatisfied), 10 to 14 (dissatisfied), 15 to 19 (slightly dissatisfied), 20 (neutral), 21 to 25 (slightly satisfied), 26 to 30 (satisfied), and 31 to 35 (extremely satisfied).

**Patient Portal Use**

Participants were identified as portal users if they selected yes to the question “Have you ever used a patient portal?” Among portal users, their portal use was assessed by frequency of use, time duration of use, and waiting time. The time of use measures the average duration each time a patient uses a portal, and frequency of use indicates how often a patient uses a portal. They are two dimensions of patient engagement with the portal. Furthermore, the waiting time from sending a request until receiving a reply was recorded. For patient portal users (ie, people who have used a portal before), their usual and maximum acceptable waiting time was asked. In contrast, for nonusers, only the maximum acceptable waiting time was recorded. Lastly, portal users’ willingness to recommend the portal to others—a strong indicator of customer loyalty and predictor for growth [34]—was measured by a single question: “Would you recommend the patient portal to others?” Portal nonusers were asked to input a percentage value (from 0 to 100) to answer the question “What is your likelihood of using such a portal?” to measure their likelihood of future portal use.

**Data Analysis**

Descriptive analysis was performed to gain insight into the patient population, portal users, and nonusers regarding their demographics, physical health status, hospital visits, and mental health status. Additionally, chi-square tests (for categorical variables) and Welch t tests (for numerical variables) were performed to compare the characteristics between portal users and nonusers. Next, univariate analyses were performed for the dependent variable (portal use) to detect its possible predictors. Variables with $P<.20$ in the univariate regression were consequently included in the multiple regression analysis after considering the correlation between variables (using statistical analysis and expert opinion). A stepwise backward elimination was then applied to reduce the number of independent variables.
and obtain the final multiple regression model. This approach allowed thorough exploration and testing of possible predictors to arrive at a final model [35]. Similar procedures were applied to the other two dependent variables (willingness to recommend among portal users and likelihood of use among portal nonusers) to get the final multiple regression models. All analyses were performed using RStudio (version 4.0.2; RStudio, PBC).

**Results**

**Descriptive Analysis**

A total of 652 respondents started the questionnaire, whereby 461 respondents completed it successfully. Only completed questionnaires were used in the final data set for analysis. Of all the participants, 307 (66.6%) reported to have used a patient portal, and 154 (33.4%) reported that they had not used a patient portal until the moment the survey was conducted.

Demographics of all participants, portal users, and nonusers are displayed in Table 1. From our sample (N=461), 94 (20.4%) were male, 365 (79.2%) were female, and 2 (0.4%) individuals identified as other. The mean age of the sample was 42.9 (SD 13.0) years. The number of participants that reported having a single chronic disease was 302 (65.5%), and 159 (34.5%) reported having multiple chronic diseases. Significant differences were noted in the mean age (P=.008) and main occupations (P=.03) between portal users and nonusers.

Table 2 displays the physical health status, hospital visits, and mental health status of all participants, portal users, and nonusers. The majority of the 461 patients reported to have their illness “a little bit” (n=113, 24.5%) to “moderately in control” (n=229, 49.7%), 66 (14.3%) reported to have total control, and 46 (10.0%) reported to have no control over their illness at all. Furthermore, few patients (n=30, 6.5%) reported that their perceived health was very good or excellent, while the majority reported good (n=177, 38.4%), or poor (n=127, 27.6%) perceived health. Moreover, the majority of respondents reported spending 0.5 hours to 1 hour (n=151, 32.8%) and 1 hour to 2 hours (n=166, 36.0%) each time they visit a hospital (including travel time); 70 (15.2%) respondents spent less than half an hour, while only 19 (4.1%) spent more than 3 hours. Furthermore, only 18 (3.9%) participants reported having or having had COVID-19, 130 (28.2%) were uncertain, and 313 (67.9%) reported that they never had COVID-19. About mental health, most participants reported having no (n=172, 37.3%) to mild forms of (n=158, 34.3%) depression, while only 9.8% (n=45) reported having moderately severe or severe depression. Relative to life satisfaction, 146 (31.7%) and 117 (25.4%) of the participants were satisfied and slightly satisfied with their lives, respectively. Moreover, 27 (5.9%) and 28 (6.1%) were extremely satisfied and extremely dissatisfied with their lives, respectively. Among the measured characteristics, level of control (P=.005), average time of hospital visits (P=.04), depression (P=.02), and life satisfaction (P=.005) were significantly different between portal users and nonusers.
Table 1. Demographics of all the participants, portal nonusers, and users during the COVID-19 pandemic in the Dutch population of patients who are chronically ill.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Total (N=461)</th>
<th>Nonusers (n=154)</th>
<th>Users (n=307)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>365 (79.2)</td>
<td>122 (79.2)</td>
<td>243 (79.2)</td>
<td>.60</td>
</tr>
<tr>
<td>Male</td>
<td>94 (20.4)</td>
<td>32 (20.8)</td>
<td>62 (20.2)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>2 (0.4)</td>
<td>0 (0.0)</td>
<td>2 (0.7)</td>
<td></td>
</tr>
<tr>
<td>Age (years), mean (SD)</td>
<td>42.9 (13.0)</td>
<td>45.1 (12.5)</td>
<td>41.8 (13.1)</td>
<td>.008</td>
</tr>
<tr>
<td>Highest education, n (%)</td>
<td></td>
<td></td>
<td></td>
<td>.09</td>
</tr>
<tr>
<td>Primary school</td>
<td>13 (2.8)</td>
<td>8 (5.2)</td>
<td>5 (1.6)</td>
<td></td>
</tr>
<tr>
<td>Secondary/high school</td>
<td>82 (17.8)</td>
<td>29 (18.8)</td>
<td>53 (17.3)</td>
<td></td>
</tr>
<tr>
<td>MBO&lt;sup&gt;a&lt;/sup&gt;,&lt;sup&gt;b&lt;/sup&gt;</td>
<td>201 (43.6)</td>
<td>73 (47.4)</td>
<td>128 (41.7)</td>
<td></td>
</tr>
<tr>
<td>HBO&lt;sup&gt;c&lt;/sup&gt;,&lt;sup&gt;d&lt;/sup&gt; or university degree</td>
<td>155 (33.6)</td>
<td>41 (26.6)</td>
<td>114 (37.1)</td>
<td></td>
</tr>
<tr>
<td>Graduate degree</td>
<td>10 (2.2)</td>
<td>3 (1.9)</td>
<td>7 (2.3)</td>
<td></td>
</tr>
<tr>
<td>Main occupation, n (%)</td>
<td></td>
<td></td>
<td></td>
<td>.03</td>
</tr>
<tr>
<td>Self-employed</td>
<td>45 (9.8)</td>
<td>11 (7.1)</td>
<td>34 (11.1)</td>
<td></td>
</tr>
<tr>
<td>Employee</td>
<td>242 (52.5)</td>
<td>73 (47.4)</td>
<td>169 (55.0)</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>35 (7.6)</td>
<td>9 (5.8)</td>
<td>26 (8.5)</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>117 (25.4)</td>
<td>50 (32.5)</td>
<td>67 (21.8)</td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>22 (4.8)</td>
<td>11 (7.1)</td>
<td>11 (3.6)</td>
<td></td>
</tr>
<tr>
<td>Yearly income (€&lt;sup&gt;e&lt;/sup&gt;), n (%)</td>
<td></td>
<td></td>
<td></td>
<td>.29</td>
</tr>
<tr>
<td>0-20,000</td>
<td>171 (37.1)</td>
<td>61 (39.6)</td>
<td>110 (35.8)</td>
<td></td>
</tr>
<tr>
<td>20,001-30,000</td>
<td>103 (22.3)</td>
<td>38 (24.7)</td>
<td>65 (21.2)</td>
<td></td>
</tr>
<tr>
<td>30,001-40,000</td>
<td>120 (26.0)</td>
<td>39 (25.3)</td>
<td>81 (26.4)</td>
<td></td>
</tr>
<tr>
<td>≥40,001</td>
<td>67 (14.5)</td>
<td>16 (10.4)</td>
<td>51 (16.6)</td>
<td></td>
</tr>
<tr>
<td>Chronic illness, n (%)</td>
<td></td>
<td></td>
<td></td>
<td>.52</td>
</tr>
<tr>
<td>Single chronic illness</td>
<td>302 (65.5)</td>
<td>104 (33.9)</td>
<td>198 (64.5)</td>
<td></td>
</tr>
<tr>
<td>Multiple chronic illnesses</td>
<td>159 (34.5)</td>
<td>50 (16.3)</td>
<td>109 (35.5)</td>
<td></td>
</tr>
<tr>
<td>Daily internet use (hours), mean (SD)</td>
<td>5.7 (4.3)</td>
<td>5.4 (4.4)</td>
<td>5.8 (4.3)</td>
<td>.60</td>
</tr>
</tbody>
</table>

<sup>a</sup>MBO: Middelbaar beroepsonderwijs.

<sup>b</sup>English translation: secondary vocational education. It is oriented toward vocational training and is equivalent to a junior college education.

<sup>c</sup>HBO: Hoger beroepsonderwijs.

<sup>d</sup>English translation: higher professional education. It is oriented toward higher learning and professional training, and is the equivalent to a college education in the United States.

<sup>e</sup>A currency exchange rate of €1=US $1.18 is applicable.
Table 2. Physical health status, hospital visits, and mental health status of all the participants, portal nonusers, and users during the COVID-19 pandemic in the Dutch population of patients who are chronically ill.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total (N=461), n (%)</th>
<th>Nonusers (n=154), n (%)</th>
<th>Users (n=307), n (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COVID-19 infection</strong></td>
<td></td>
<td></td>
<td></td>
<td>.72</td>
</tr>
<tr>
<td>Yes</td>
<td>18 (3.9)</td>
<td>101 (65.6)</td>
<td>212 (69.1)</td>
<td></td>
</tr>
<tr>
<td>Not sure</td>
<td>130 (28.2)</td>
<td>46 (29.9)</td>
<td>84 (27.4)</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>313 (67.9)</td>
<td>7 (4.5)</td>
<td>11 (3.6)</td>
<td></td>
</tr>
<tr>
<td><strong>Level of control</strong></td>
<td></td>
<td></td>
<td></td>
<td>.005</td>
</tr>
<tr>
<td>Totally</td>
<td>66 (14.3)</td>
<td>28 (18.2)</td>
<td>38 (12.4)</td>
<td></td>
</tr>
<tr>
<td>Moderately</td>
<td>229 (49.7)</td>
<td>63 (40.9)</td>
<td>166 (54.1)</td>
<td></td>
</tr>
<tr>
<td>A little bit</td>
<td>113 (24.5)</td>
<td>41 (26.6)</td>
<td>72 (23.5)</td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>46 (10.0)</td>
<td>16 (10.4)</td>
<td>30 (9.8)</td>
<td></td>
</tr>
<tr>
<td>I don’t know</td>
<td>7 (1.5)</td>
<td>6 (3.9)</td>
<td>1 (0.3)</td>
<td></td>
</tr>
<tr>
<td><strong>Perceived health (SRH(^a))</strong></td>
<td></td>
<td></td>
<td></td>
<td>.31</td>
</tr>
<tr>
<td>Excellent</td>
<td>4 (0.9)</td>
<td>2 (1.3)</td>
<td>2 (0.7)</td>
<td></td>
</tr>
<tr>
<td>Very good</td>
<td>26 (5.6)</td>
<td>8 (5.2)</td>
<td>18 (5.9)</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>127 (27.5)</td>
<td>36 (23.4)</td>
<td>91 (29.6)</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>177 (38.4)</td>
<td>57 (37.0)</td>
<td>120 (39.1)</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>127 (27.5)</td>
<td>51 (33.1)</td>
<td>76 (24.8)</td>
<td></td>
</tr>
<tr>
<td><strong>Average time of hospital visit (hours)</strong></td>
<td></td>
<td></td>
<td></td>
<td>.04</td>
</tr>
<tr>
<td>&lt;0.5</td>
<td>70 (15.2)</td>
<td>32 (20.8)</td>
<td>38 (12.4)</td>
<td></td>
</tr>
<tr>
<td>0.5-1</td>
<td>151 (32.8)</td>
<td>42 (27.3)</td>
<td>109 (35.5)</td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td>166 (36.0)</td>
<td>56 (36.4)</td>
<td>110 (35.8)</td>
<td></td>
</tr>
<tr>
<td>2-3</td>
<td>55 (11.9)</td>
<td>21 (13.6)</td>
<td>34 (11.1)</td>
<td></td>
</tr>
<tr>
<td>&gt;3</td>
<td>19 (4.1)</td>
<td>3 (1.9)</td>
<td>16 (5.2)</td>
<td></td>
</tr>
<tr>
<td><strong>Depression (PHQ-9(^b))</strong></td>
<td></td>
<td></td>
<td></td>
<td>.02</td>
</tr>
<tr>
<td>None</td>
<td>172 (37.3)</td>
<td>56 (36.4)</td>
<td>116 (37.8)</td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>158 (34.3)</td>
<td>49 (31.8)</td>
<td>109 (35.5)</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>86 (18.7)</td>
<td>25 (16.2)</td>
<td>61 (19.9)</td>
<td></td>
</tr>
<tr>
<td>Moderately severe</td>
<td>33 (7.2)</td>
<td>15 (9.7)</td>
<td>18 (5.9)</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>12 (2.6)</td>
<td>9 (5.8)</td>
<td>3 (1.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Life satisfaction</strong></td>
<td></td>
<td></td>
<td></td>
<td>.005</td>
</tr>
<tr>
<td>Extremely satisfied</td>
<td>27 (5.9)</td>
<td>6 (3.9)</td>
<td>21 (6.8)</td>
<td></td>
</tr>
<tr>
<td>Satisfied</td>
<td>146 (31.7)</td>
<td>44 (28.6)</td>
<td>102 (33.2)</td>
<td></td>
</tr>
<tr>
<td>Slightly satisfied</td>
<td>117 (25.4)</td>
<td>28 (18.2)</td>
<td>89 (29.0)</td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td>21 (4.6)</td>
<td>10 (6.5)</td>
<td>11 (3.6)</td>
<td></td>
</tr>
<tr>
<td>Slightly dissatisfied</td>
<td>70 (15.2)</td>
<td>27 (17.5)</td>
<td>43 (14.0)</td>
<td></td>
</tr>
<tr>
<td>Dissatisfied</td>
<td>52 (11.3)</td>
<td>24 (15.6)</td>
<td>28 (9.1)</td>
<td></td>
</tr>
<tr>
<td>Extremely dissatisfied</td>
<td>28 (6.1)</td>
<td>15 (9.7)</td>
<td>13 (4.2)</td>
<td></td>
</tr>
</tbody>
</table>

\(^{a}\)SRH: Self-Rated Health.  
\(^{b}\)PHQ-9: Patient Health Questionnaire 9.

Table 3 reports the frequency of portal use before and after the lockdown. An increase in the frequency of portal use has been observed after the lockdown as compared to before, whereby the relative difference was 500%, 221.1%, and 8.3% in daily, weekly, and monthly use, respectively. After the lockdown, 67 (21.8%) reported daily to weekly use, and 106 (34.5%) have...
used the patient portal monthly. Among all the portal users, the most common use times were “5 minutes or less” (n=121, 39.4%) and “5-10 minute” (n=124, 40.4%), while 62 (20.2%) of them reported using the portals for more than 10 minutes.

In relation to the maximum acceptable waiting time, nonusers reported a lower maximum acceptable waiting time than users.

Among the users, 78 (28.4%) reported a longer actual waiting time than they deem acceptable. Finally, among portal users, 257 (83.7%) would likely recommend portals to others, and among nonusers, the average likelihood of future use (ranging from 0% to 100%) was 53.6% (SD 33.3%).

### Table 3. Descriptive of patient portal use before and after lockdown (n=307).a

<table>
<thead>
<tr>
<th>Portal use</th>
<th>Frequency of use before lockdown, n</th>
<th>Frequency of use after initiation of lockdown, n</th>
<th>Relative difference (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Almost) daily</td>
<td>1</td>
<td>6</td>
<td>500</td>
</tr>
<tr>
<td>Weekly</td>
<td>19</td>
<td>61</td>
<td>221.1</td>
</tr>
<tr>
<td>Monthly</td>
<td>56</td>
<td>106</td>
<td>89.3</td>
</tr>
<tr>
<td>Less than monthly</td>
<td>231</td>
<td>134</td>
<td>–42.0</td>
</tr>
</tbody>
</table>

aRelative comparison between periods translated according to relative frequency of use (period before the intelligent lockdown had a much larger timespan than the period after initiation of the intelligent lockdown and thus included portal nonusers).

### Multiple Regression Analysis

To investigate which combinations of the different predictors could best explain the variance in portal use versus nonuse and portal users’ willingness to recommend and portal nonusers’ likelihood of future use, three separate regression models were constructed after performing univariate regression analysis and considering possible correlations. In the first analysis (model 1), a logistic regression was performed to investigate the association between portal use and the included variables after the first steps, which were age, hospital visit time, level of control, depression, and life satisfaction. In the second analysis (model 2), a logistic regression was performed to study the relationship between portal users’ willingness to recommend and the variables average number of hours spent on the internet daily, the frequency of portal use after the COVID-19 lockdown in March 2020, waiting time for portal response, and maximum acceptable time to wait. In the third analysis (model 3), a multiple regression analysis was conducted between portal nonusers’ likelihood of use and age, income, maximum acceptable waiting time, and their awareness of patient portals’ existence as candidate variables. The results of the regression analysis are displayed in Table 4.

Regression results of model 1 showed that shorter hospital visit times (“less than half an hour”) predict less portal use ($\beta=-.725; P=.03$) compared to longer visit times. Compared to “totally under control,” moderate level of control predicts a higher chance ($\beta=.629; P=.04$) of portal use. Two mental health conditions were shown to significantly affect participants’ portal use. Participants with severe depression ($\beta=-1.652; P=.03$) and life dissatisfaction or extreme life dissatisfaction ($\beta=-.844; P<.001$) were found to be less likely to use patient portals. Furthermore, age demonstrates a small yet nonsignificant impact on portal use, whereby older age negatively affects portal use ($\beta=-.015; P=.08$).

Among portal users, the logistic regression results from model 2 showed that actual waiting time and maximum acceptable waiting time were the strongest predictors of users’ willingness to recommend. Participants whose average waiting time was between 1 to 2 days ($\beta=-2.081; P<.001$) or greater than 2 days ($\beta=-1.784; P<.001$) were less likely to recommend the portal system to others, compared to those who received responses via portal systems within 24 hours. Participants who reported a moderate maximum waiting time (1-2 days) were more likely to recommend portal systems ($\beta=2.292; P<.001$).

For portal nonusers (model 3), awareness of the portal existence was the strongest predictor besides maximum acceptable waiting time. Among nonusers, 85 (55.2%) reported being unaware of the existence of a patient portal at their hospital. Participants that were unaware of the existence of portal systems were 25.9% ($P<.001$) more likely to use portal systems, compared to those that already knew of their existence before the time of the survey. Participants who had a moderate maximum acceptable waiting time (12-24 hours) were 21.2% ($P<.001$) more likely to use portal systems in the future. Furthermore, middle income class participants ($\leq$30,001 [US $35,440.20] to $40,000 [US $47,252.00]) were 15.3% ($P=.01$) more likely to use portal systems compared to low income class participants ($<20,001 [US $23,627.20]$), and older-aged participants also showed a slightly lower likelihood ($\beta=-.003; P=.10$) of use.
Table 4. Results of the multiple regression model, indicating the significant predictors.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model 1 portal use (all participants)</th>
<th>Model 2 recommendation (portal users)</th>
<th>Model 3 likelihood of using (portal nonusers)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimates</td>
<td>P value</td>
<td>Estimates</td>
</tr>
<tr>
<td>Intercept</td>
<td>1.513</td>
<td>.004</td>
<td>0.685</td>
</tr>
<tr>
<td>Age</td>
<td>−0.015</td>
<td>.08</td>
<td>N/A*</td>
</tr>
<tr>
<td>Income (€(^b); reference: 0-20,000)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20,001-30,000</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>30,001-40,000</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>≥40,001</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Daily internet hours</td>
<td>N/A</td>
<td>N/A</td>
<td>0.093</td>
</tr>
<tr>
<td>Hospital visit time (hours; reference: 0.5-1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;0.5</td>
<td>−0.725</td>
<td>.03</td>
<td>N/A</td>
</tr>
<tr>
<td>1-2</td>
<td>−0.246</td>
<td>.35</td>
<td>N/A</td>
</tr>
<tr>
<td>2-3</td>
<td>−0.548</td>
<td>.12</td>
<td>N/A</td>
</tr>
<tr>
<td>&gt;3</td>
<td>0.613</td>
<td>.37</td>
<td>N/A</td>
</tr>
<tr>
<td>Level of control (reference: totally)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately</td>
<td>0.629</td>
<td>.04</td>
<td>N/A</td>
</tr>
<tr>
<td>Little bit</td>
<td>0.328</td>
<td>.36</td>
<td>N/A</td>
</tr>
<tr>
<td>Not at all</td>
<td>0.823</td>
<td>.08</td>
<td>N/A</td>
</tr>
<tr>
<td>I don’t know</td>
<td>−1.825</td>
<td>.11</td>
<td>N/A</td>
</tr>
<tr>
<td>Depression scale (reference: mild)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>−0.147</td>
<td>.58</td>
<td>N/A</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.259</td>
<td>.43</td>
<td>N/A</td>
</tr>
<tr>
<td>Moderately severe</td>
<td>−0.321</td>
<td>.45</td>
<td>N/A</td>
</tr>
<tr>
<td>Severe</td>
<td>−1.652</td>
<td>.03</td>
<td>N/A</td>
</tr>
<tr>
<td>Life satisfaction scale (reference: satisfied or more)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slightly satisfied</td>
<td>0.116</td>
<td>.69</td>
<td>N/A</td>
</tr>
<tr>
<td>Neutral</td>
<td>−1.009</td>
<td>.05</td>
<td>N/A</td>
</tr>
<tr>
<td>Slightly dissatisfied</td>
<td>−0.589</td>
<td>.08</td>
<td>N/A</td>
</tr>
<tr>
<td>Dissatisfied or less</td>
<td>−0.844</td>
<td>.02</td>
<td>N/A</td>
</tr>
<tr>
<td>Portal use COVID-19 (reference: daily)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly or more</td>
<td>N/A</td>
<td>N/A</td>
<td>1.269</td>
</tr>
<tr>
<td>3-5 times</td>
<td>N/A</td>
<td>N/A</td>
<td>2.050</td>
</tr>
<tr>
<td>1-2 times</td>
<td>N/A</td>
<td>N/A</td>
<td>0.124</td>
</tr>
<tr>
<td>Waiting time (reference: less than 24 hours)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2 days</td>
<td>N/A</td>
<td>N/A</td>
<td>−2.081</td>
</tr>
<tr>
<td>&gt;2 days</td>
<td>N/A</td>
<td>N/A</td>
<td>−1.784</td>
</tr>
<tr>
<td>Never tried</td>
<td>N/A</td>
<td>N/A</td>
<td>−0.911</td>
</tr>
<tr>
<td>No possibility</td>
<td>N/A</td>
<td>N/A</td>
<td>−0.681</td>
</tr>
<tr>
<td>Maximum acceptable waiting time (reference: &lt;12 hours)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-24 hours</td>
<td>N/A</td>
<td>N/A</td>
<td>1.187</td>
</tr>
<tr>
<td>1-2 days</td>
<td>N/A</td>
<td>N/A</td>
<td>2.292</td>
</tr>
<tr>
<td>&gt;2 days</td>
<td>N/A</td>
<td>N/A</td>
<td>1.502</td>
</tr>
</tbody>
</table>


Discussion

Main Findings and Comparison With Other Studies

Although the societal and health impacts of the COVID-19 pandemic have been present for nearly a year, there is no evidence on factors that affect patient portal adoption among patients who are chronically ill during the COVID-19 pandemic. Moreover, little research has been done on what influences users’ willingness to recommend and nonusers’ likelihood of using patient portals during the COVID-19 pandemic. Our findings portray some interesting insights for portal service providers and health care professionals.

In the participant population under study, we found that almost 67% (307/461) of participants were portal users, which is much higher than for general patient populations reported [36-38]. For example, Griffin et al [36] found in their study that 83.4% of patients were nonusers of the UNC Chart patient portal among a general patient population. It could be attributed to the difference in the study population and the impact of the COVID-19 pandemic. Ancker et al [39] found that patients with chronic illness were more likely to use a patient portal. Table 3 shows that both the number of portal users and frequency of use have increased significantly after the lockdown initiation in spring 2020. We found that participants whose level of control was moderate had a higher likelihood of using portal systems than participants with total control. This may be attributed to participants’ perception whereby they deem a portal as unnecessary when their health is well managed and under control.

Besides, we found that participants with shorter visit times to a hospital have a reduced likelihood of portal use compared to those with longer visit times. As reported in many other studies [40-42], savings on travel time and cost are among the major benefits of eHealth. This result suggests that the convenience of physical visits most likely reduces remote visits using patient portals. Furthermore, participants with severe depression and lower life satisfaction tend to use patient portals less. Mental health problems likely deter patients from using portal systems. This result coincides with the observation that patients with chronic anxiety and depression are less likely to be intense eHealth users [37]. Future studies should focus on determinates of portal use and nonuse in this specific population.

Our results show that older age may negatively affect portal use. It is in line with a recent study in the older population on the intention to use medical applications. Feelings of having control, service availability, perceived ease of use and usefulness, and attitude toward the medical application affect the intention to use in older adults, which may be attributed to anxiety triggered by technology use, lack of privacy, or trust [43]. Another study also argues that this is probably because older people often lack the infrastructure, knowledge, and skills needed to use eHealth programs [44]. Future studies are required to investigate determinants of portal use and nonuse in the older adult population.

Willingness to recommend patient portal systems was also investigated. No less than 83.7% reported willingness to recommend the portal to family and friends, which suggests that most users were satisfied and loyal with their hospital's patient portal system [34]. The average waiting time to receive a response was a strong predictor for users’ positive experience using portal systems. Approximately 29% of patients reported receiving responses within 2 hours of a request, which is considered rapid. Numerous studies in the appointment scheduling area have shown the importance of managing waiting time in health care management [45-47]. Marketing research has shown that waiting time is a crucial determinant of customer satisfaction and loyalty [48]. Nonusers seem to expect faster response rates from patient portals than users. Palawatta [49] demonstrated that if nonusers perceive the response rate is longer than their perceived acceptable waiting time, they will feel less satisfied and, therefore, less inclined to try the portal system. Users, if they experience disconfirmation in waiting time and maximum acceptable waiting time, are likely to be less satisfied and therefore less likely to remain committed to using the portal system. These are essential insights for health care practitioners and managers to leverage operational efficiencies such as appointment scheduling and resource allocation.

Among the nonuser group, the majority (85/154, 55%) reported not being aware of a patient portal system at their hospital. Awareness of portal systems was found to be the largest predictor for future use in our study. It seems that many patients do not use portals partly due to unawareness of their existence. This result is in line with Griffin et al [36], who found that patients often did not use patient portals simply because they were unaware of their existence. This result suggests that
enhancing the awareness of portal systems is the first step for health care organizations to take to increase portal use.

Limitations and Future Research

There are some limitations bound to this study. First, the survey is cross-sectional, making it impossible to make causal claims, limiting the study to predictions only. Furthermore, the study relies on self-reported data on portal use. This is because when the study was implemented, we did not have access to the actual use data, such as log data of portal users. Besides, this survey focused on both portal users and nonusers to study factors that influence portal use and future use of nonusers. This, for example, cannot be replicated by merely approaching the actual users. However, it would be more insightful to use real use data (eg, log data retrieved from the portal) to establish the length and frequency of use. We suggest this as a future study when access to portal data is possible.

Second, the study invited participants via social media (Facebook peer support group) to complete the self-administered questionnaire. On one hand, sampling from Facebook support groups has apparent benefits, such as convenience and its focus on the targeted population. On the other hand, it also has a few known biases [50,51]. For example, Facebook excludes people who have a lower eHealth literacy, one important predictor of portal use among adult patients [22]. Besides, not everybody uses Facebook, especially older people. Although this problem is partly compensated by focusing on the age group 18 to 65 years, our results might overestimate the proportion of portal users among the total population. This partly explains why the ratio of portal users is higher than reported in many other studies. Little is known about the characteristics of people who do not use technology and why they do not use the portal. We suggest that future studies should focus on older people and people with less eHealth literacy.

Moreover, more females than males participated in this study. According to Smith [52], females are more likely to respond to (online) surveys than males. The authors proposed different reasons that could be grounded to this observation, including behavioral differences between males and females in relation to the internet or inherent internal feelings. Another study [53] found similar results (70% female response).

Finally, it is important to see which functionalities users use and the respective frequency to understand the perceived value of these functionalities to patients. This will potentially improve the frequency of use and tailoring portal systems according to the needs of patient. Future research could build on our results, aimed at further investigation of the use dimension of patient portals.

Conclusion

Individuals that have spent less time on physical hospital visits, whose health is moderately under control or with severe depression or lower life satisfaction are less likely to use patient portal systems. Among users, short waiting time was the most important predictor for satisfaction of portal use, and among nonusers, awareness was the most important predictor of future portal system use. These findings provide insights for health care providers on how to promote patient portal use and improve user satisfaction.

Acknowledgments

We would like to express our gratitude to those who have helped to establish this study. First, we would like to thank all of the participants for their contribution. Second, we would like to thank the Erasmus Research Institute of Management for funding support. Furthermore, we would like to thank Dr Stephen Zhang for providing professional help on the survey design.

Conflicts of Interest

None declared.

References


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**Abbreviations**

IRB: Institutional Review Board
MI-PACE Home-Based Cardiac Telerehabilitation Program for Heart Attack Survivors: Usability Study

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Abstract

Background: Cardiac rehabilitation programs, consisting of exercise training and disease management interventions, reduce morbidity and mortality after acute myocardial infarction.

Objective: In this pilot study, we aimed to developed and assess the feasibility of delivering a health watch–informed 12-week cardiac telerehabilitation program to acute myocardial infarction survivors who declined to participate in center-based cardiac rehabilitation.

Methods: We enrolled patients hospitalized after acute myocardial infarction at an academic medical center who were eligible for but declined to participate in center-based cardiac rehabilitation. Each participant underwent a baseline exercise stress test. Participants received a health watch, which monitored heart rate and physical activity, and a tablet computer with an app that displayed progress toward accomplishing weekly walking and exercise goals. Results were transmitted to a cardiac rehabilitation nurse via a secure connection. For 12 weeks, participants exercised at home and also participated in weekly phone counseling sessions with the nurse, who provided personalized cardiac rehabilitation solutions and standard cardiac rehabilitation education. We assessed usability of the system, adherence to weekly exercise and walking goals, counseling session attendance, and disease-specific quality of life.

Results: Of 18 participants (age: mean 59 years, SD 7) who completed the 12-week telerehabilitation program, 6 (33%) were women, and 6 (33%) had ST-elevation myocardial infarction. Participants wore the health watch for a median of 12.7 hours (IQR 11.1, 13.8) per day and completed a median of 86% of exercise goals. Participants, on average, walked 121 minutes per week (SD 175) and spent 189 minutes per week (SD 210) in their target exercise heart rate zone. Overall, participants found the system to be highly usable (System Usability Scale score: median 83, IQR 65, 100).

Conclusions: This pilot study established the feasibility of delivering cardiac telerehabilitation at home to acute myocardial infarction survivors via a health watch–based program and telephone counseling sessions. Usability and adherence to health watch use, exercise recommendations, and counseling sessions were high. Further studies are warranted to compare patient outcomes and health care resource utilization between center-based rehabilitation and telerehabilitation.

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Introduction

Cardiac rehabilitation provides longitudinal cardiopulmonary exercise training with additional disease management interventions to patients with cardiovascular diseases [1,2]. Participation in cardiac rehabilitation is guideline-recommended after many acute cardiovascular events because it can lower cardiovascular mortality, reduce hospital readmissions, and improve quality of life [3,4]. However, many eligible patients never receive referrals for cardiac rehabilitation, and a high proportion of patients who receive referrals never enroll [5-10]. This may be due to numerous factors, such as cost of enrollment, lack of motivation, or inadequate patient education regarding the benefits of cardiac rehabilitation [2]. In a scientific statement from the American Association of Cardiovascular and Pulmonary Rehabilitation, the American Heart Association, and the American College of Cardiology in 2019 [2], it was suggested that less than 1 in 6 patients participated in cardiac rehabilitation after hospitalization for myocardial infarction. Diverse patient, community, health care provider, hospital system, and insurance factors contribute to the persistent underutilization of cardiac rehabilitation [5-7,11]. Typically, outpatients perform cardiac rehabilitation in a dedicated facility under clinician supervision with limited scheduling hours. Difficulties in scheduling, traveling, and financing center-based cardiac rehabilitation help to drive poor enrollment and retention in cardiac rehabilitation [6,12].

Delivery of cardiac rehabilitation using contemporary telecommunication and smart device technologies (cardiac telerehabilitation, ie, tele-CR) may reduce logistical and financial barriers associated with cardiac rehabilitation by facilitating cardiac rehabilitation in the home [13-16]. The ability to perform cardiac rehabilitation at home may increase participation while providing comparable outcomes for patient health-related quality of life, exercise capacity, and mortality [17-21]. Consumers increasingly use internet-connected mobile and wearable devices to monitor fitness [22]; therefore, they may find tele-CR preferable to center-based cardiac rehabilitation. Furthermore, telehealth platforms can also potentially compound and extend the clinical effectiveness of cardiac rehabilitation for patients who have completed ambulatory center-based programs [23].

Despite the widespread need for rehabilitation after acute myocardial infarction and technological innovations in this space, wearable device–based rehabilitation solutions are still being studied for evidence to support their adoption and use, though recent developments have significantly advanced this area of research [23-26]. The development of a user-centered platform that is acceptable to patients and can impact key clinical or patient-reported outcomes will likely be a critical component of the clinical adoption of tele-CR [14]. In this study, we examined the usability of and adherence to a nurse-supported 12-week telerehabilitation intervention after acute myocardial infarction for patients who declined to participate in conventional rehabilitation. We conducted exploratory analyses to also examine changes in disease-specific quality of life rehabilitation.

Methods

Study Setting and Sample

All adults who were hospitalized at a single tertiary academic medical center in central Massachusetts for acute myocardial infarction between June and November 2018 were screened for eligibility by trained research assistants using International Classification of Disease Tenth Revision codes, problem lists, laboratory results, and electrocardiogram (ECG) findings, as validated in other studies [27]. Patients between 40 and 80 years, fluent and literate in English, meeting clinical indications for cardiac rehabilitation, and with access to an environment or facilities to perform exercise were eligible for inclusion (Figure 1). Patients who preferred to enroll in conventional center-based cardiac rehabilitation, planned to receive follow-up cardiovascular care outside of our hospital system, were unable to participate in follow-up sessions, had subsequent myocardial infarction, had no health insurance, were unable to provide informed consent, were unable to ambulate, were unable to adhere to study protocols, had unstable angina, had serious medical conditions that precluded study participation (for example, cancer), had no symptoms at the time of their presentation for myocardial infarction, underwent cardiac surgery, and were staying in the intensive care unit were excluded. We only targeted patients who chose to forego traditional, center-based cardiac rehabilitation to provide an alternative cardiac rehabilitation delivery modality; if a patient was deemed appropriate for center-based cardiac rehabilitation by their primary medical team, and agreed to enroll, we opted to avoid interfering with their prescribed management. Research assistants approached potential participants who had acute myocardial infarctions (and their care teams) prior to their discharge. Participants provided written informed consent for study participation and received training on study devices and procedures.
Figure 1. Recruitment flow diagram. MI: myocardial infarction; ICU: intensive care unit.

Study Overview

Each patient obtained a stress test within 4 weeks of screening and enrollment. At an in-person baseline visit, each participant received a watch and tablet, as well as device training. The baseline assessment during their index hospitalization included questions on perceptions of cardiac rehabilitation and disease-specific quality of life. Per standard of care for conventional cardiac rehabilitation, each participant needed to complete a clinically indicated stress test within 4 weeks of hospital discharge to assess safety for exercise and establish target heart rates for rehabilitation activities. A Bruce protocol [28] was followed, and baseline ECG, heart rate, and blood pressure were closely monitored prior to, during, and after exercise. This exercise test is divided into successive stages of increasing intensity, and patients are asked about symptoms throughout. A report is generated upon conclusion of the test and interpreted by medical staff—physician (author DDM) screened all exercise test results for abnormal findings that might place participants at risk from participation in cardiac rehabilitation; participants with concerning results were excluded from the study and referred to follow up with their treating physician. Participants with no abnormal stress test findings attended the in-person training session, during which a trained study staff member provided oral and written instructions for telerehabilitation activities at home.
Components of the Telerehabilitation Program

The MI-PACE tele-CR program included a validated wearable device (Health Watch [29]; Philips Healthcare) that was connected via Bluetooth to an Android tablet computer (Tab 4; Lenovo Group Limited). An app displayed goals and progress for exercise and walking. There was a dashboard for the cardiac rehabilitation nurse to enter the goals and to view the progress of the patients. Counseling and education sessions with the nurse were scheduled weekly over the 12-week study period.

Cardiac Rehabilitation Methods

Research staff instructed participants to complete a set number of walking sessions (light intensity) consisting of bouts of at least 2 minutes, and moderate to vigorous intensity exercise sessions. Rehabilitation counseling sessions were designed by the cardiac rehabilitation nurse and cardiologist (authors AP and DDM, respectively) a priori and were standardized to include components from center-based cardiac rehabilitation programs. Each participant’s target heart rate range was set by the cardiac rehabilitation nurse based on the participant’s resting and maximum heart rate and performance on the exercise stress test in accordance with conventional cardiac rehabilitation practices [30]. The number and duration of prescribed exercise and walking sessions was determined based on (1) the participant’s level of physical activity prior to their acute myocardial infarction, (2) the participant’s level of activity after the acute myocardial infarction, (3) exertional chest pain after their cardiac event, (4) orthopedic limitations, and (5) the participant’s perceptions of their difficulty achieving exercise target goals. Weekly goals were subject to modification based on the participant’s performance the preceding week. Successful completion of goals prompted an increase in the frequency or duration of the sessions, whereas a low completion percentage resulted in maintaining or decreasing the frequency or duration of sessions (with a minimum of 2 walking and 2 exercise sessions per week).

The cardiac rehabilitation nurse reviewed participant data, advised participants on weekly goals, and screened for any issues related to abnormal heart rate. Heart rate zones were modified by the nurse if new medications were prescribed or based upon a treating clinician’s advice. Each week, the cardiac rehabilitation nurse contacted the participants at a time deemed preferable by the participant to perform a cardiac rehabilitation session (Multimedia Appendix 1) to review exercise and walking goal completion, check heart rate values, address concerns, and deliver standard cardiac rehabilitation modules on heart disease management (ie, smoking cessation, weight management, stress management). At the end of 12-week program, the study participant returned the health watch and tablet at a study visit and completed an exit interview, which consisted of the baseline assessment components in addition to questions regarding exercise motivation and system usability in the context of the MI-PACE program. The analytical sample for this study comprised participants who completed the full 12-week program. The Philips Internal Committee for Biomedical Experiments and the University of Massachusetts Medical School institutional review board (H00013769) reviewed and approved this study.

Primary Study Outcomes

The primary study outcomes included measures of adherence to components of the cardiac rehabilitation system and its general usability. We examined adherence to the individual component with the following measures: health watch daily wear time in hours, proportion of completed weekly telephone counseling sessions, and proportion of exercise and walking sessions reaching the target duration. Completion of an exercise session was determined based on the number of minutes spent in or above the target exercise heart rate zone. Any exercise time spent below this heart rate zone was not considered cardiac rehabilitation exercise and was not counted toward the exercise goal. Completion of a tele-cardiac rehabilitation session was recorded by the cardiac rehabilitation nurse.

To assess the usability of the MI-PACE system, participants completed the 10-item System Usability Scale (SUS) at the end of the program [31]. Participants rated factors such as complexity, ease of use, and confidence in operating the system on a 5-point Likert-type scale (strongly disagree, disagree, neutral, agree, strongly agree). SUS scores have a range of 0 to 100, with higher scores indicating greater usability. SUS scores of 68 or higher are considered to indicate good usability [32].

Secondary Study Outcomes

We measured participants’ daily step counts during the study period. We also determined adherence to wearing the health watch over the course of the study, by operationally defining a day of wear as registering more than 1000 steps and wearing the health watch for more than 2 hours. Participants also completed walking goals distinct from their exercise goals, defined by minutes spent walking in bouts of at least 2 minutes (regardless of them being in the target exercise heart rate zone). Participants completed the Seattle Angina Questionnaire (SAQ) [33] to assess disease-specific quality of life at baseline and at the end of the study. The SAQ has 5 scales assessing physical limitation, angina stability, angina frequency, treatment satisfaction, and quality of life that are each scored from 0 to 100, with higher scores indicating greater disease-specific quality of life. Expert panels consider changes ≥16.0 points to be clinically meaningful [34].

Clinical Variables

Trained study staff abstracted data on participants’ demographic, clinical, treatment, and laboratory characteristics during their index hospitalization from electronic health records—key clinical, electrocardiographic, and laboratory variables (troponin, ECG ST-segment changes, systolic blood pressure, and creatinine levels upon admission, history of renal dysfunction, Killip classification, use of diuretics, and instances of cardiac arrest)—to calculate the Global Registry of Acute Coronary Events (GRACE) risk scores a validated instrument [35], to ascertain severity of acute myocardial infarction and short-term prognosis. Study staff also abstracted baseline ECG information, exercise performance, and presence of symptoms from the stress test performed at study entry.
Statistical Analyses
Baseline demographic and clinical characteristics for participants are presented using percentages for categorical variables, means with standard deviations for continuous variables with normal distributions, and medians with first and third quartile values for continuous variables with skewed distributions. To examine changes in cardiac rehabilitation behaviors over the course of the study, we plotted the weekly median value and interquartile ranges for participants’ mean daily health watch wear time, median and interquartile ranges of daily step count, and mean proportion of weekly exercise goals completed.

We compared baseline to end-of-study scores for the SAQ scales using Wilcoxon matched-pair signed-ranks tests due to skewed distributions.

Results
Sample Size and Baseline Characteristics
Overall, study staff screened 420 inpatient admissions for study eligibility, of whom 62 (15%) met eligibility criteria. Of the 62 patients who were eligible, 57 were approached, and 31 (54.4%) consented to participate and completed baseline interviews. Of these 31 individuals, participation in the cardiac telerehabilitation program was deemed to be safe for 20 individuals who successfully completed the baseline stress test (Figure 1). Two participants withdrew prematurely (one due to an unplanned vascular surgery and another because their cardiologist recommended transition to center-based cardiac rehabilitation); the remaining 18 participants (90%) completed the 12-week tele-CR program.

Of participants who completed the 12-week tele-CR program (n=18; age: mean 58 years, SD 7) (Table 1), 6 (33%) were women, 16 (89%) were non-Hispanic White individuals, 6 (33%) had been hospitalized for ST-segment elevation myocardial infarction, and the median GRACE score was 92.2 (IQR 82.2, 104.4). Notably, 9 (50%) and 7 (39%) participants reported travel and inadequate time, respectively, as obstacles to participating in center-based cardiac rehabilitation.
Table 1. Baseline characteristics of patients who completed the 12-week telerehabilitation program.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value (n=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), mean (SD)</td>
<td>58 (7)</td>
</tr>
<tr>
<td><strong>Sex, n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>6 (33)</td>
</tr>
<tr>
<td>Male</td>
<td>12 (67)</td>
</tr>
<tr>
<td><strong>Race and ethnicity, n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>16 (89)</td>
</tr>
<tr>
<td>Middle Eastern</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Unspecified</td>
<td>1 (6)</td>
</tr>
<tr>
<td><strong>BMI(^a) (kg/m(^2)), median (IQR)</strong></td>
<td>29.1 (27.3, 33.8)</td>
</tr>
<tr>
<td><strong>Clinical characteristics(^b), n (%)</strong></td>
<td></td>
</tr>
<tr>
<td>Atrial fibrillation or flutter</td>
<td>2 (11)</td>
</tr>
<tr>
<td>Chronic kidney disease</td>
<td>4 (22)</td>
</tr>
<tr>
<td>Depression</td>
<td>3 (17)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2 (11)</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>14 (78)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>9 (50)</td>
</tr>
<tr>
<td>Prior myocardial infarction</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Obstructive sleep apnea</td>
<td>2 (11)</td>
</tr>
<tr>
<td>Currently smokes</td>
<td>1 (6)</td>
</tr>
<tr>
<td><strong>Index hospitalization data</strong></td>
<td></td>
</tr>
<tr>
<td>ST-segment elevation myocardial infarction, n (%)</td>
<td>6 (33)</td>
</tr>
<tr>
<td><strong>GRACE(^c) risk score, median (IQR)</strong></td>
<td>92.2 (82.2, 104.4)</td>
</tr>
<tr>
<td>Maximum troponin level (mg/dL), median (IQR)</td>
<td>3.5 (0.8, 18.7)</td>
</tr>
<tr>
<td>Percutaneous coronary intervention, n (%)</td>
<td>14 (78)</td>
</tr>
<tr>
<td>Left ventricle ejection fraction (%), mean (SD)</td>
<td>58.8 (9.7)</td>
</tr>
<tr>
<td><strong>Baseline cardiac rehabilitation stress test data</strong></td>
<td></td>
</tr>
<tr>
<td>Total exercise time (minutes), mean (SD)</td>
<td>8.4 (3.0)</td>
</tr>
<tr>
<td>Metabolic equivalent of task (METs), median (IQR)</td>
<td>10.1 (7.6, 13.4)</td>
</tr>
</tbody>
</table>

\(^a\)BMI: body mass index.

\(^b\)Percentages do not add to 100 because patients may have more than 1 condition.

\(^c\)GRACE: Global Registry of Acute Coronary Events.

Adherence to Wearing Health Watch

Participants wore the study health watch for a median of 61 (73%) of 84 study days (IQR 35, 78) over the 12-week study period and for a median of 12.7 hours (IQR 11.1, 13.8) per day (Table 2). Daily health watch wear time was consistent over the 12-week study period, with a mean decrease in wear time of 0.06 hours (95% CI −0.15 to 0.02 hours) per week (Figure 2).

Table 2. Adherence metrics to the telerehabilitation program.

<table>
<thead>
<tr>
<th>Adherence metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily wear time, median (IQR)</td>
<td>12.7 (11.1, 13.8)</td>
</tr>
<tr>
<td>Days worn, median (IQR)</td>
<td>61 (35, 78)</td>
</tr>
<tr>
<td>Mean percentage of exercise goals met</td>
<td>86.0</td>
</tr>
<tr>
<td>Mean percentage of walking goals met</td>
<td>33.6</td>
</tr>
<tr>
<td>Mean percentage of phone sessions completed</td>
<td>91.7</td>
</tr>
</tbody>
</table>

https://humanfactors.jmir.org/2021/3/e18130
Exercise and Walking

Overall, participants completed a mean of 86% of prescribed exercise goals over the 12-week study period (Table 2). Participants completed a smaller proportion of exercise assignments over time, and there was an average decline of 8% (95% CI 3% to 13%) completion of prescribed exercise goals per additional study week (Figure 3). The overall percentage of completed walking goals for the entire study was 34% (Table 2). Completion of prescribed walking goals remained unchanged over the duration of the study with a mean weekly increase in completion rate of 1% (95% CI −12% to 14%) per additional week. The median of each participant’s average daily count was 6023 steps (IQR 3940, 6920). Participants’ daily step counts remained steady over the 12-week study period, with an average increase of 15 steps (95% CI −71 to 101) per additional week (Figure 4).

On average, participants walked 121 minutes per week (SD 175); the average number of walking minutes increased by 2.7 minutes per additional study week. On average participants spent 189 minutes per week (SD 210) in their exercise heart rate zone; the average number of exercise minutes decreased by 0.55 minutes per additional study week.
Figure 4. Median daily step count by study week.

Adherence to Tele-CR sessions
The lowest number of telephone counseling sessions attended by a participant was 7 out of 12, and the median number of weekly tele-CR sessions attended was 11, with 8 out of 18 participants attending all 12 sessions.

Health-Related Quality of Life
Quality of life ($P=.12$), self-perception of physical limitation ($P=.79$), angina frequency ($P=.67$), and treatment satisfaction ($P=.42$) scores did not change significantly from baseline to study completion; however, there was a significant improvement in participants’ perceptions of their angina stability (baseline: median 50, IQR 41.7, 91.7; after tele-CR: median 100, IQR 50.0, 100; $P=.003$) (Table 3).

Table 3. Seattle Angina Questionnaire Quality of Life scores for survivors of an acute myocardial infarction who completed a 12-week telerehabilitation program (n=18).

<table>
<thead>
<tr>
<th>Seattle Angina Questionnaire domains(^a)</th>
<th>Score, median (IQR)</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>12 weeks</td>
</tr>
<tr>
<td>Physical limitation</td>
<td>98.6 (77.8, 100)</td>
<td>100 (77.8, 100)</td>
</tr>
<tr>
<td>Angina stability</td>
<td>50.0 (50.0, 50.0)</td>
<td>100 (50.0, 100)</td>
</tr>
<tr>
<td>Angina frequency</td>
<td>90.0 (80.0, 100)</td>
<td>100 (75.0, 100)</td>
</tr>
<tr>
<td>Treatment satisfaction</td>
<td>100 (81.3, 100)</td>
<td>100 (90.6, 100)</td>
</tr>
<tr>
<td>Quality of life</td>
<td>50.0 (41.7, 91.7)</td>
<td>50.0 (50.0, 91.7)</td>
</tr>
</tbody>
</table>

\(^a\)Each scale has a range from 0 to 100, with higher scores indicating better quality of life.

Usability and Motivation
The median SUS score was 82.5 (IQR 65.0, 90.0). Overall, 82% of participants (14/17) reported that the system motivated them to be physically active, and 82% (14/17) also reported that the system helped them to achieve physical activity recommendations. About a third of participants agreed that, because of the system, they walked and exercised more than they previously had (Table 4).
Table 4. Perception of usability and motivation among survivors of an acute myocardial infarction who completed a 12-week telerehabilitation program.

<table>
<thead>
<tr>
<th>Items</th>
<th>Participants endorsing (n=18), n (%)</th>
<th>Disagree or strongly disagree</th>
<th>Don’t know or neutral</th>
<th>Agree or strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System usability</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Would use frequently&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 (0)</td>
<td>2 (12)</td>
<td>15 (88)</td>
<td></td>
</tr>
<tr>
<td>Found unnecessarily complex&lt;sup&gt;b&lt;/sup&gt;</td>
<td>14 (88)</td>
<td>0 (0)</td>
<td>2 (13)</td>
<td></td>
</tr>
<tr>
<td>Easy to use&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3 (18)</td>
<td>0 (0)</td>
<td>14 (82)</td>
<td></td>
</tr>
<tr>
<td>Need technical support&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12 (71)</td>
<td>2 (12)</td>
<td>3 (18)</td>
<td></td>
</tr>
<tr>
<td>Functions well integrated&lt;sup&gt;a&lt;/sup&gt;</td>
<td>4 (24)</td>
<td>1 (6)</td>
<td>12 (71)</td>
<td></td>
</tr>
<tr>
<td>Too much inconsistency&lt;sup&gt;a&lt;/sup&gt;</td>
<td>8 (47)</td>
<td>0 (0)</td>
<td>9 (53)</td>
<td></td>
</tr>
<tr>
<td>People can learn to use quickly&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2 (12)</td>
<td>1 (6)</td>
<td>14 (82)</td>
<td></td>
</tr>
<tr>
<td>System awkward to use&lt;sup&gt;a&lt;/sup&gt;</td>
<td>14 (82)</td>
<td>0 (0)</td>
<td>3 (18)</td>
<td></td>
</tr>
<tr>
<td>Self-confidence using system&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1 (6)</td>
<td>2 (12)</td>
<td>14 (82)</td>
<td></td>
</tr>
<tr>
<td>Need to learn a lot prior to use&lt;sup&gt;b&lt;/sup&gt;</td>
<td>13 (81)</td>
<td>1 (6)</td>
<td>2 (13)</td>
<td></td>
</tr>
<tr>
<td><strong>Motivation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The system motivates me to walk and exercise&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1 (6)</td>
<td>2 (12)</td>
<td>14 (82)</td>
<td></td>
</tr>
<tr>
<td>The system helps me to follow the walking and exercise recommendation&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1 (6)</td>
<td>2 (12)</td>
<td>14 (82)</td>
<td></td>
</tr>
<tr>
<td>Thanks to the system I walk and exercise more than before&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5 (29)</td>
<td>6 (35)</td>
<td>6 (35)</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Missing responses (n=1) were not included in the denominator of percentage calculations.

<sup>b</sup>Missing responses (n=2) were not included in the denominator of percentage calculations.

**Major Medical and Safety Events**

No participants reported injuries or major adverse medical events in connection with their cardiac rehabilitation or study activities. There were no instances of recurrent cardiac events or death among participants over the course of the study.

**Discussion**

**Principal Findings**

In this study, we demonstrated that patients hospitalized after acute myocardial infarction who declined to participate in center-based cardiac rehabilitation participated in alternative cardiac telerehabilitation, which comprised a wearable watch, a cardiac rehabilitation app for review of exercise and walking goals, and scheduled telephone sessions with a cardiac rehabilitation nurse, found it to be acceptable. We observed moderately high rates of adherence to exercise recommendations and telephone counseling sessions.

Most indices of disease-specific quality of life remained stable over the 12-week study period; however, perceived angina stability improved. No adverse events were observed among study participants. Participants completing the 12-week cardiac rehabilitation intervention reported the cardiac rehabilitation system to be usable and motivating for physical activity. These results suggest that a nurse-assisted cardiac telerehabilitation program with an internet-connected app and wrist-based wearable device may be an acceptable alternative for patients eligible for but who decline to participate in center-based cardiac rehabilitation.

**Participation Adherence**

Participants were generally adherent to the tele-CR program. Participants’ health watch wear time and step count averages remained stable throughout the entire 12-week program, which is consistent with findings of other cardiac telerehabilitation studies [4].

The exercise and walking goals were collaboratively set by each patient and the cardiac rehabilitation nurse and thus were individualized. Participants completed a high portion of their exercise goals. We observed a slight decline in adherence to exercise goals over the 12-week study period. These goals are based on achieving heart rate targets, and in combination with the steady step count data, our results may indicate that participants’ exercise intensities slightly declined over time. In particular, when fitness levels improve, the same exercise routine may result in a slightly lower heart rate. Another possible reason for this decrease in exercise goal adherence over the study may be because weekly exercise goals were generally increased if the previous week’s goals were met, and consequently, participants who successfully completed prior weekly exercise recommendations may have found it increasingly difficult to achieve new exercise targets.
The overall percentage of completed walking goals was lower (34%) than that of completed exercise goals (86%), but remained constant over the 12-week study period. We hypothesize that the health watch walking time algorithm, which required that participants walk for 2 continuous minutes (no breaks lasting longer than 10 seconds) in order for the time period to be counted, may have led to underestimation of participants’ true walking time. Consistent with this hypothesis, participants in our study reported during their exit survey that interrupted or short walks were not counted toward their walking time. Despite the limitations of the approach used in our study, other activity trackers use similar approaches. For example, Fitbit counts active minutes only after 10 minutes of continuous moderate-to-intense activity [36]. In the future, we may consider lowering the walking time threshold for older adults participating in tele-CR.

Nearly half of the participants completed all 12 tele-CR sessions with the study cardiac rehabilitation nurse, and we observed high adherence to phone sessions throughout the program, though adherence was higher in the first half of the study than that in the second (95% in the first 6 weeks and 87% in the second). Although patient education is a core component of many telerehabilitation protocols [18,26,37], many models tend to utilize technology to implement passive unidirectional communication as opposed to engaging the patient in active education such as (eg, shared decision making in setting goals and assessing their overall needs with respect to their cardiac health). In fact, previous research on tele-CR that used unidirectional patient education concluded that additional telephone support and more intensive coaching would be valuable [38,39]. Our participants nearly unequivocally mentioned support from the cardiac rehabilitation nurse as a highlight of the program and as one of its most important components. The enthusiasm and patience of the cardiac rehabilitation nurse as mentioned by many of the patients is likely to be a major contributor to the high adherence rates to the cardiac rehabilitation nurse sessions.

### Usability and Motivation

Participants generally expressed enthusiasm for their experience with the MI-PACE system (SUS score: median 82.5, IQR 65.0, 90.0) and responses on motivation assessments. Recent studies [23,40,41] with tele-CR systems similar to ours reported mean SUS scores of 76 [41], 75 [40] and 65.5 [23], suggesting that tele-CR systems generally show acceptable usability despite the comorbidity and impairment burden of the target population. While the SUS has been validated for use as a complete instrument, examining its individual domains may provide specific insight into different aspects of usability. The item asking about inconsistencies in the system appears to be the only item to generate a wide distribution of responses (Table 4). This heterogeneity in response is likely due to challenges that some participants faced with walking time detection using the health watch; the fact that short and intermittent walks did not contribute to their total walking time discouraged some participants.

Participants overwhelmingly endorsed that the tele-CR system increased their motivation to perform physical activity and helped them with reaching their physical activity targets (82% for both). A much lower proportion of patients reported that the system directly increased their level of physical activity (35%). In this study, participants achieved a high level of physical activity. Participants walked for an average of 121 minutes per week (SD 175) and spending 189 minutes per week (SD 210) in their personal exercise heart rate zone. Participants’ average walking time (121 minutes per week) falls below the recommended 150 minutes of weekly moderate-intensity exercise [1], but walking time may have been underestimated by the health watch. Furthermore, the observed average of 189 minutes spent in the exercise heart rate zone is considerably greater than the 75 minutes of vigorous-intensity exercise per week recommended by the American Heart Association, which indicates that participants generally achieved adequately high levels of exercise [42].

### Disease-Specific Quality of Life

Angina stability improved significantly (P=.003) in tele-CR participants over the 12-week study period. The lack of statistical significance in other domains (quality of life: P=.12; self-perception of physical limitation: P=.79; angina frequency: P=.67; treatment satisfaction: P=.42) is not surprising in light of the fact that the tele-CR program was not designed to address all facets of clinical care (ie, medical treatment). Significant change in these domains is likely to require longer follow-up. It should also be noted that our study was not sufficiently powered to detect small differences in SAQ (n=18). However, our results are consistent with those of other studies [26,43] demonstrating that the effects of cardiac telerehabilitation on disease-specific and health related quality of life are mixed. For example, though it has been suggested that angina frequency may improve after 6 weeks of cardiac rehabilitation [44], other cohort studies [44,45] show no significant associations between cardiac rehabilitation participation and domains of health related quality of life. Further research is needed to elucidate component factors of cardiac rehabilitation that may contribute to changes in health related quality of life domains to clarify why they are observed in only a subset of studies.

### Telerehabilitation and Mobile Health Technology

The use of mobile and wearable technologies for heart rate and activity monitoring has revolutionized many aspects of health care, and cardiac rehabilitation is a promising area for leveraging remote monitoring to improve cardiovascular outcomes. Whereas earlier cardiac telerehabilitation programs focused on web-based portals and providing additional communications channels for patients during the rehabilitation process [17], more recent studies [18,20,21,46] have begun to utilize biosensors in wearable devices to both monitor progress and inform exercise interventions. There appears to be increasing interest in support of leveraging near-continuous biomonitoring from mobile devices to generate real-time feedback in order to individualize recommendations and maximize potential patient benefits in tele-CR. In addition, systematic reviews and meta-analyses have shown the noninferiority of home-based cardiac rehabilitation compared to traditional center-based approaches with respect to virtually all relevant outcomes [17,37], and further studies suggest that costs of tele-CR are at least comparable, if not
lower than, those incurred by center-based cardiac rehabilitation [15,18,20].

Very little research, however, has focused on assessing the usability and feasibility of telemonitoring programs in a patient population fraught with a heavy burden of comorbidities (such as a cardiac rehabilitation patient population) or the organizational and systemic challenges in implementing such programs. Involving all stakeholders is important, as they are critical to successfully implement a tele-CR program. Potential differences between the number and quality of health care provider visits delivered through tele-CR versus those delivered through conventional cardiac rehabilitation further emphasize the importance of addressing human factors in tele-CR design processes [47]. Ideally, users or prescribers of the tele-CR system should be involved throughout the process, using a participatory design model, and feedback should be elicited from the patients, their caretakers, health care professionals, and health care company specialists [48]. Recently, a tele-CR intervention whose developers heavily engaged target users in the development process [49] subsequently demonstrated high ease of use (reported by participants) [23], which illustrates the need for stakeholder engagement. Involvement of all stakeholders maximizes the likelihood of designing an end product that is highly usable and addresses the needs of each relevant party to ensure successful clinical application. There is significant value in understanding the nuances surrounding the specific use of devices as well as the myriad of relevant process variables in implementation in tele-CR. This is not only an important step toward the goal of widespread dissemination and adoption of tele-CR, but arguably, a necessary one.

This study contributes to a very sparse knowledge base regarding the usability of, and adherence to, a health watch-based tele-CR program. The intervention and supportive care environment enabled by weekly interactions with a trained cardiac rehabilitation nurse and our findings from the data provided by the wearable device indicate that this specific model of tele-CR may be an acceptable alternative to center-based cardiac rehabilitation as patients overwhelmingly gave high usability ratings for the system.

**Implementation Strategy**

Design of the study’s protocol necessitated careful consideration of implementation strategies in order to ensure its success. The device support provided by study staff throughout the study appears to be an important component of a positive patient experience. While participants were contacted by the study cardiac rehabilitation nurse weekly, the nurse’s role did not encompass technical support, and patients generally reported that the availability of study staff for questions regarding the watch and tablet system, both at the initial study visit as well as the duration of their enrollment, had been important to their success in use. This demonstrates the utility of having the necessary support staff to meet patient needs, both in research as well as in clinical practice, with respect to answering technical questions when they arise. One challenge that arose during implementation of this study was the need to streamline patient recruitment while respecting the clinical decisions made by their primary medical teams. Study participation required medical procedures (a stress test) not directly recommended by their medical teams, and thus, that were potentially difficult to integrate into the patient care workflow (and with consequent medical expenditures). Minimizing disruptions to routine patient care and integrating clinical research into existing health care systems is key for the success of similar projects and to ensure patient safety.

**Study Strengths and Limitations**

The strengths of this study include the use of a population of patients who were eligible for cardiac rehabilitation but who declined center-based rehabilitation, the use of a tele-CR program informed by data from a validated wrist-based wearable device [29], the integration of a remote cardiac rehabilitation nurse to review data and provide standardized and scalable cardiac rehabilitation–specific health education using conventional methods of cardiac rehabilitation counseling, use of validated indices of usability and disease-specific quality of life, and objective monitoring of participants’ levels of physical activity after acute myocardial infarction. We acknowledge several limitations: the small sample size, low proportion of eligible to screened patients, and study design that focused on feasibility, adherence, and usability all contribute potential biases that may limit interpretability of the results. Selection bias may have resulted in a population with high baseline physical activity, with participants maintaining, rather than increasing, their physical fitness, which is limits generalizability to other cardiac rehabilitation populations. The study was not powered to identify individual factors associated with cardiac rehabilitation adherence or to determine the effect of cardiac rehabilitation on clinical or patient-reported outcomes (n=18). Additionally, the study cohort was relatively fit at baseline (median MET 10.6), and there may be bias with respect to the potential for activity increase over the course of the 12 weeks. Finally, we did not systematically assess contextual factors related to study implementation or physical fitness postintervention.

**Conclusions**

Cardiac telerehabilitation with a wearable device for patients after acute myocardial infarction had high usability ratings as well as high rates of adherence to health watch use, exercise recommendations, and telephone counseling sessions, with no associated adverse outcomes reported. Telerehabilitation with wearables may be an alternative for patients who are eligible but unable to participate in center-based cardiac rehabilitation. Additional studies with larger patient samples are warranted to compare patient outcomes and health care resource utilization for center-based rehabilitation to those of telerehabilitation.
Acknowledgments

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Conflicts of Interest

DDM received sponsored research grant support from Bristol-Myers Squibb, Boehringer-Ingelheim, Pfizer, Flexcon, Fitbit, Philips Healthcare, and Biotronik and has received consultancy fees from Bristol-Myers Squibb, Pfizer, Flexcon, Boston Biomedical Associates, and Rose Consulting. WS is an employee of Philips Research.

Multimedia Appendix 1

(A) Health Watch, (B) screenshot of patient-facing PACE app, (C) screenshot of patient list in the provider-facing PACE app, and (D) screenshot of heart rate graph in the provider-facing PACE app.

References


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Therapists’ Experience of Video Consultation in Specialized Mental Health Services During the COVID-19 Pandemic: Qualitative Interview Study

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Abstract

Background: As part of political and professional development with increased focus on including service users within mental health services, these services are being transformed. Specifically, they are shifting from institutional to noninstitutional care provision with increased integration of the use of electronic health and digitalization. In the period from March to May 2020, COVID-19 restrictions forced rapid changes in the organization and provision of mental health services through the increased use of digital solutions in therapy.

Objective: The aim of this study was to develop and advance comprehensive knowledge about how therapists experience the use of video consultation (VC). To reach this objective, we evaluated therapists’ experiences of using VC in specialized mental health services in the early phase of COVID-19 restrictions. The following questions were explored through interviews: Which opportunities and challenges appeared when using VC during the period of COVID-19 restrictions? In a short-term care pathway, for whom does VC work and for whom does it not work?

Methods: This study employed a qualitative approach based on an abductive strategy and hermeneutic-phenomenological methodology. Therapists and managers in mental health departments in a hospital were interviewed via Skype for Business from March to May 2020, using a thematic interview guide that aimed to encourage reflections on the use of VC during COVID-19 restrictions.

Results: Therapists included in this study experienced advantages in using VC under circumstances that did not permit face-to-face consultations. The continuity that VC offered the service users was seen as a valuable asset. Various negative aspects concerning the therapeutic environment such as lack of safety for the most vulnerable service users and topics deemed unsuitable for VC lowered the therapists’ overall impression of the service. The themes that arose in the data analysis have been categorized in the following main topics: (1) VC—“it’s better than nothing”; (2) VC affects therapists’ work situation—opportunities and challenges in working conditions; and (3) challenges of VC when performing professional assessment and therapy on the screen.

Conclusions: Experiences with VC in a mental health hospital during COVID-19 restrictions indicate that there are overall advantages to using VC when circumstances do not permit face-to-face consultations. Nevertheless, various negative aspects in the use of VC lowered the therapists’ overall impression of VC. Further qualitative research is needed, and future studies should focus on service users’ experiences, cocreation between different stakeholders, and how to scale up the use of VC while ensuring that the service provided is appropriate, safe, and available.

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KEYWORDS
mental health services; recovery, telemedicine; telepsychiatry; video consultation; COVID-19; coronavirus; therapists’ experiences; hospital services

Introduction

Research Context
Mental health service provision in Norway is changing, and there is an increase in noninstitutional care provision for people with long-term mental health problems [1]. One central area of attention is the provision of follow-up care at a distance, including the use of electronic consultations and video consultations (VC) within mental health services in hospitals, which has become more common in recent years [2,3]. Nevertheless, implementation of VC has been slow [4,5]. However, in the period from March to May of 2020, the COVID-19 restrictions enforced a radical change in how health care services were organized. A need to find alternative solutions to face-to-face consultations emerged to enable safe treatment of service users without risk of contagion. The use of VC in different parts of the health care service increased; as such, during the first period of restrictions due to COVID-19, therapists and service users were forced to use technology to communicate, whether or not they had experience with this kind of technology. The pandemic thus became a magnifying glass, revealing both challenges and advantages in the use of VC. This increased use of VC raises questions concerning how the technology may affect both the quality and availability of services in mental health, especially with regard to following up with those in recovery and in need of complex and long-term services.

Reasons for seeking help from mental health services are often based on negative experiences in relationships and difficulties in coping with everyday life. There is a need to tailor digital services to promote recovery and change in service users’ mental health state, and to support and improve social relations and coping strategies in the context of everyday life [6,7]. Along the continuum of service provision, VC may be used as part of follow-up care in certain phases of the helping process. In some cases, VC can offer new opportunities for understanding and treating mental health experiences in context. This, in turn, can lead to a greater emphasis on psychosocial approaches, involving service users and carers as active partners in care provision, and refocusing outcomes of services to align with daily life, employment, and other aspects of social inclusion. By contrast, the use of VC may prove challenging for therapists when they seek a comprehensive understanding of the service user’s complex situation within their individual context. A final, but equally important, question that has emerged alongside the increased use of VC concerns the impact it has on therapists’ work situation [8] and how they cope with the technology in their therapeutic relationships.

Background
Norway’s national health and hospital plan [1] emphasizes the goal of realizing a sustainable health care service based on each service user’s needs at all levels of the service provided. Both in the meeting between the service user and the therapist, and in the development of the health and care services, the vulnerable voice of the service user must be heard. As part of political and professional development along with an increased focus on including service users within mental health services, services are being transformed; specifically, they are shifting from institutional to noninstitutional care provision with increased use of electronic health (eHealth) and digitalization [1]. Integrating video as a consultation platform is part of the innovation strategy described in Norway’s latest national health and hospital plan [1].

The use of VC underscores a shift in the focus of care from treating service users in hospital departments to flexible models within the continuum of care. This change is aimed at increasing the focus on recovery-oriented services [5,9]. Recovery in mental health is a concept that has had a range of definitions over the past several decades [10,11]. The concept is used both to describe an approach and as the process the individual goes through to improve their mental health. These two definitions are interlinked in that recovery as an approach has developed from being described as an individual process [12]; currently, the inclusion of social recovery, and relational and contextual factors are emphasized [13,14]. Being in recovery from severe mental health illness is often a complex process that involves a range of stakeholders, including both professionals and peer support [14-16], and it is often described as a process in which the service user is in the driver’s seat for their own recovery to live a self-directed life [11]. In this expanded view of recovery, digital solutions such as VC may have an impact on the process of recovery in numerous ways [9]. The recovery tradition also emphasizes the service user as a human being and not as a diagnosis [10,17]; moreover, in this tradition, the use of language is seen as an important tool to empower individuals with mental health problems, and especially to reduce stigma [18,19]. The term “service user” rather than “patient” is used to refer to people in treatment for mental health problems. “Patient” is a defined role and a theoretical construct closely linked to a medical perspective, and it is a concept used to define, both legally and professionally, an individual receiving any kind of health service.

The use of communication technologies and tools in assessment and therapy in mental health services is not a new phenomenon [4], and there are many different terms used to designate digital treatment, including “telehealth,” “telepsychiatry,” “telepsychology,” “eHealth,” “telemedicine,” and “video consultations” [4]. In this paper, we use “VC” to refer to an online meeting between a therapist and a service user. There is also a substantial body of research on the use of telehealth in mental care. A recent review of the field of telepsychiatry highlights the use of digital solutions as an effective way to improve access, enhance quality, and provide efficient care [4,20]. VC contributes to the provision of services in the service user’s home or other local settings, which may empower the service user, incorporate their voice, and contextualize their mental health problems as part of their everyday life. This
promotes the opportunity for the service user to participate in their own recovery process, which is considered important from a recovery perspective [4,7,21,22]. A crisis assessment study on the use of VC in acute mental care in Norway underscores the opportunity to provide continuous follow-up care for people in acute crisis, despite geographical distances and lack of psychiatrists in certain regions [23]. Use of VC between the therapists and the service user strengthened the involvement of the service user during the crisis assessment; specifically, it reduced uncertainty, created shared responsibility for decisions, and functioned as a safety net, even when the use of VC was not required [23-25]. Other recent studies on the use of telecare indicate that follow-up treatment at a distance for people with different diagnoses and backgrounds is effective and safe; these studies included both elderly people with depression and veterans in recovery from posttraumatic stress syndrome [3,26-29]. With regard to the former group, use of VC in therapy with elderly people suggests that VC supports mental health practice, especially as a useful alternative when face-to-face therapy is not possible [30]. Initial skepticism often disappears once the VC is experienced in action; any residual challenges seem to be related to technical problems and a lack of support from staff [31,32].

In general, findings from the above-mentioned studies indicate that the use of VC in treatment may be an efficient way to provide therapy. However, several of these were pilot studies, in which the implementation occurred in a limited area of the service with selected service users and therapists. We know that this kind of approach can lead to self-selection bias, as pilot studies often attract digitally optimistic and mature participants [32]. There can thus be a mismatch between pilot studies and real-world implementation; indeed, when the service has been implemented within the daily operations of a hospital, additional challenges have been revealed [32]. A study on experiences of VC implementation within the everyday operation of a mental health hospital is therefore essential, which will offer new knowledge for the field. Extant research also shows that from the service users’ perspective, both lack of face-to-face contact and technical challenges were seen as barriers [8,33], whereas from the health care providers’ perspective, physical presence and reading of subtle signs are central in high-quality care [34].

To date, few qualitative studies have dealt with in-depth experiences with the use of VC and recovery in mental health that included both therapists and service users. Given this gap, this study focused on therapists’ experiences and addressed the following research questions: Which opportunities and challenges appeared when using VC during the period of COVID-19 restrictions? In a short-term care pathway, for whom does VC work and for whom does it not work?

Case Context
This study was performed at a hospital located in northern Norway, which is a sparsely populated rural area. As the distances between service users and the hospital can be considerable, the hospital has worked to implement technologies for distance communication for decades. The VC system in use during the study period was Skype for Business, which the hospital had been using in this capacity for 3 years. Some of the therapists in the hospital’s mental health departments were experienced users of telecare and VC, both in terms of professional collaboration and therapy, with steady use over several years. This characteristic, however, does not apply to all of the therapists in the region. The data extracted from the electronic patient journal (EPJ) system show that the number of consultations in mental health care performed over video has been low, but the use has seen a slow annual increase in recent years. In 2017, 1% of all consultations were performed using video. In 2019, this number increased to 4%, and during the COVID-19 restrictions, the use of VC saw a dramatic increase. On March 12, 2020, Norway completely locked down, which meant that all public institutions—including schools, kindergartens, and offices—closed. During this period (March 15-30, 2020), 72% of all of consultations were performed over video. Owing to a decreasing rate of infection, the restrictions were slowly relaxed in mid-April; however, several restrictions remained in place [35]. Taking local levels of infection into consideration, permission to perform face-to-face consultations (with multiple safeguards in place regarding infection control) was granted. The use of VC thus slowly diminished once again, comprising only 21% of all consultations in the last part of May 2020 (Table 1).

Table 1. Use of video consultations in the hospital.

<table>
<thead>
<tr>
<th>Period</th>
<th>Performed video consultations, n (%)</th>
<th>Performed face-to-face consultations, n</th>
<th>Total consultations, N</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017</td>
<td>178 (0.7)</td>
<td>27,563</td>
<td>27,741</td>
</tr>
<tr>
<td>2018</td>
<td>956 (3.2)</td>
<td>28,569</td>
<td>29,525</td>
</tr>
<tr>
<td>2019</td>
<td>1188 (4.1)</td>
<td>28,032</td>
<td>29,220</td>
</tr>
<tr>
<td>January 1 to March 15, 2020</td>
<td>341 (5.4)</td>
<td>5984</td>
<td>6325</td>
</tr>
<tr>
<td>March 16-30, 2020</td>
<td>352 (72)</td>
<td>139</td>
<td>491</td>
</tr>
<tr>
<td>April 2020</td>
<td>718 (58)</td>
<td>524</td>
<td>1242</td>
</tr>
<tr>
<td>May 2020</td>
<td>463 (21)</td>
<td>1748</td>
<td>2211</td>
</tr>
</tbody>
</table>
Methods

Research Design
A qualitative, explorative study using in-depth interviews was performed in a mental health hospital. The methodological approach was based in the social sciences, using an abductive strategy that aimed to uncover—and then interpret—knowledge about the social actors in question [36]. This entailed investigating how the therapists experienced, understood, and created a context for using VC in therapeutic meetings with their service users. This perspective worked well with the hermeneutic-phenomenological approach we employed in our analysis; moreover, our choice of research strategy was integrated into the objectives of the study and the research questions under investigation. For the purposes of this study, a hermeneutic-phenomenological perspective meant that the researchers sought an in-depth understanding of the participants’ real-world experiences around the use of VC during COVID-19 restrictions [37,38]. Further, the researchers’ own hermeneutic position entailed acknowledging that although the data collection and analysis were undertaken with a reflexive and open-minded view, the theoretical approach and researchers’ preconceptions would also affect the results.

Interviews
In-depth interviews following a semistructured interview guide were conducted in late March to mid-May 2020, 2 weeks after the COVID-19 restrictions were introduced in Norway. The interviews were conducted on video. The first author (MG) conducted all interviews, and opened each interview by asking the therapist to tell a story about when, how, and why they had implemented VC in their mental health service for the first time. An interview guide was developed beforehand with the aim of mapping the implementation and use of VC from different perspectives; this guide was sent out to all informants prior to the interview. The interview guide was primarily used as a checklist as the interview progressed into more of a conversation. The interviewer was mindful of the fact that conducting interviews in this way may lead to a different information flow than that occurring in a face-to-face meeting, and that while the main objective of the abductive research strategy is to gain in-depth understanding of each participant’s perceptions, the use of digital tools may (negatively or positively) affect the process.

Selection and Sample
When the COVID-19 restrictions were implemented, one of the recommendations for mental health workers was to follow up with service users by using VC [39]. A qualitative study had already been planned at the hospital on different aspects, insecurity related to communicating on video, and that while the main objective of the abductive research strategy is to gain in-depth understanding of each participant’s perceptions, the use of digital tools may (negatively or positively) affect the process. A total of 14 participants from different disciplines and departments were recruited. The participants worked with adults, adolescents, and children, in addition to performing family therapy; 13 were therapists and 1 was a department head. There was diversity in age, gender, and professional background among the informants: the youngest was 27 and the oldest was 66 years old at the time of the interviews, and there were 3 men and 11 women, 5 of whom had 6 or more years of education, whereas the rest had 3 or more years of experience. In this context, “therapists” is used to denote mental health professionals who are trained to provide treatments in different ways; as such, in this study, the therapists were psychiatrists, psychologists, nurses, and social workers with at least 3 years of university education.

Analysis
All interviews were recorded and transcribed verbatim. The transcriptions were undertaken by a professional firm just after the interviews were completed. To validate the content, the first author read all of the transcriptions and compared them to the recorded interviews. The analysis was performed through a reflexive, open-minded, and abductive process, which enabled an intuitive understanding of the meaning of the text as a whole [36]. Following the initial in-depth reading of the interviews, the content was categorized and grouped together to identify important themes according to the research questions. The themes in the analysis arose through an iterative process of reading and interpreting to identify meaningful units [36-38].

Ethics Approval and Considerations
The study was approved in advance by the ethical committee (PVO) at Helse Nord (project ID 2462). The participants were given both written and verbal information about the study before agreeing to participate. The included informants sent their consent forms via mail to the first author, which were stored without any connection to the gathered data material.

Results

Main Themes
Data were analyzed and categorized with regard to the research questions: Which opportunities and challenges appeared when using VC during the period of COVID-19 restrictions? In a short-term care pathway, for whom does VC work and for whom does it not work? According to the therapists, being forced to initiate the use of VC during COVID-19 restrictions to follow up with service users resulted in both positive and negative experiences. They also expressed an overall perception that the video format offered a necessary opportunity to maintain contact with service users during a challenging and abnormal period. However, several challenges were introduced when the VC was implemented, including the low quality of certain technological aspects, insecurity related to communicating on video, and challenges in managing the service users’ reluctance to participate in VC. The themes that arose during data analysis were categorized into three main topics: (1) VC—“it’s better than nothing”; (2) VC affects therapists’ work situation—opportunities and challenges in working conditions;
and (3) challenges of VC when performing professional assessment and therapy on screen.

VC—“It’s Better Than Nothing”

VC Promotes Continuity and Access to Service

As indicated by the analysis of data extracted from the EPJ system (see Table 1), the use of VC skyrocketed in the period immediately following the introduction of COVID-19 restrictions. This was also noted by one of the therapists interviewed: “I haven’t counted, but I can bet that as many as 85% to 90% of the consultations in the last 2 weeks were on Skype.” Conducting consultations on video allowed the treatment to continue despite the societal lockdown. For some service users, this was valuable; however, the therapists described several service users as reluctant to participate in VC, preferring to wait for the restrictions to ease to continue regular face-to-face treatment instead. From the therapists’ point of view, it was emphasized that VC allowed for closer follow-up and continuity in the treatment of the service users during the COVID-19 lockdown. In some cases, they found it important to encourage service users who were skeptical about the video format to participate in VC to secure continuity and enable follow-up care regarding potentially serious mental health problems. Further, the therapists reported that VC made it easier for service users with social anxiety to take part in consultations, similar to the benefits for users with mobility disabilities or those who worked offshore. They also emphasized how continuity is important when following up with service users with suicidal thoughts; here, a key element is scheduling future appointments to which the service user can look forward, and VC made this possible during the lockdown. Despite these positives, the therapists felt that the quality of the service was affected by the video format. One of the therapists described this challenge as follows:

> It’s like baking your favorite cake with artificial sweeteners instead of sugar—it will work, and it tastes and looks okay, but there is something missing, it’s not the same quality. However, it’s definitely better than nothing.

Establishing and Maintaining a Relationship on Video

Initiating a therapeutic relationship on video can be challenging for both the service user and the therapist. The first conversation on video was described as generally consisting of an introduction to the service user’s progress plan, or, in some cases, a risk assessment concerning the severity of the service user’s suicide risk. The latter was found to be especially difficult to achieve on video. Meeting new service users on video could cause insecurity on both sides of the screen and, as one therapist mentioned, although it is always necessary to ensure that confidence and balance are established in the relationship, this is especially important when the initial consultation is on video. Indeed, one of the informants explained that if the therapist feels insecure with the video format, this can affect the power relations between the service user and the therapist. Another therapist felt it was important to provide information to the service user about how to communicate on VC and explain how the pathway of recovery would be addressed on video. Overall, the therapists agreed that it is preferable to meet the service users for the first time face to face to establish a good relationship, and that this would help make future consultations on video less scary and more productive. When employed in consultations with service users they already knew, the therapists felt that video could be a useful tool:

> Yes, it was a new [service user] and we had not been able to meet physically, so we had the first consultation on Skype. This was a person I knew in advance and [the service user] also knew who I was, so we were not totally strangers to each other. It worked fine.

It should also be noted that some therapists did experience positive first meetings on video with new service users, although it helped when the therapist and the service user already knew one another. As one of the therapists stated: “I did not complete my education in psychology to meet people on a screen. I want to see them face to face.”

Some of the therapists found VC involving children and adolescents to be particularly challenging, as these service users could experience meeting the therapist on video as frightening in the absence of the natural human comfort and security a face-to-face meeting can provide:

> Today we had a little 3-year-old who wanted to see us, but then she didn’t dare. “Oh no, I don’t dare,” she said. We had a very good conversation with the parents, but it can be a challenge for youngsters to join.

Nevertheless, therapists also reported positive experiences, in which children felt safe in the video conversations because the video format allowed them to be in their own home. Some adolescents were quite familiar with the video and internet format, and felt that they could control it—and were more in control when using it—regarding what to choose to display and present on video. However, given the above experiences, some of the therapists were surprised to find that some adolescent service users avoided VC. One possibility to explain this presented was that if it was the service users’ family who wanted them to receive treatment, the service users may have been using reluctance toward VC as an excuse to avoid therapeutic consultations. Nevertheless, the therapists highlighted that just because adolescent service users may be in a digitally mature age group and are used to online communication among themselves on social media, this does not necessarily imply a positive attitude toward VC:

> I don’t know if it’s about talking to a professional or having some kind of treatment, that makes it difficult? I used to do phone calls, too, but it was hard to get mentally close and open up in the conversation. And maybe when you meet face to face you know better how to get into the right topics, maybe? I do not know.

With regard to family treatment, several of the therapists raised concerns about using video in consultations, as the focus in this kind of therapy is on creating a relationship with the service user (child) in their own home and monitoring the interaction between the child and the parents. The natural situation is
difficult to observe on video, and the therapists feared that important aspects of the children’s behaviors were not displayed accurately on screen. The parental guidance consultations, in which only the parents are being guided by the therapist, and the interaction aspect (although beyond the scope of this study) were pointed to by therapists as working well on video.

**VC Affects Therapists’ Work Situation—Opportunities and Challenges in Working Conditions**

**Barriers to Effective Communication**

On the one hand, working together using video provides an opportunity for closer follow-up and more flexibility in meetings both with service users and with colleagues, including collaborating with providers in other services. On the other hand, therapists also felt that their working conditions were negatively impacted by the video format, and that the communication with the service users changed when it occurred on the screen; as such, they described finding it difficult to make clinical judgments and experienced insecurity regarding the service users’ conditions. Several of the therapists revealed that they became exhausted and frustrated when performing VC for an entire workday and that communicating through the screen required a different kind of presence than face-to-face meetings.

You get pretty dizzy in your head when you talk to people on Skype. Some conversations last up to, erm, on average, it can last for an hour. But it depends on where you are in the course of treatment. I think you get tired in a different way in, in your head, when you have spent all day on the screen, sitting and talking like that.

The therapist quoted above had thought it might be easier to conduct consultations on the screen, as not being in the same room could eliminate the potential influence of emotions from the service user. Other therapists also elaborated on the differences between face-to-face and video consultations. One therapist mentioned:

If we look at the amount [of VC], it would have been really okay to have some consultations face to face to get variety. When all consultations were on video...well, I don’t know how to describe it. It is uncomfortable and it doesn’t feel like a good way to work.

During face-to-face consultations, small breaks often appear naturally during the conversation, and a break while one or the other is thinking feels safe and leads perhaps to a necessary pause in the conversation. In consultations on the screen, these small breaks can feel unnatural. As one therapist noted,

The contact feels a little reduced, a little more strained. You sit there staring. It is a deadlocked situation and it is difficult to take breaks. Breaks in the conversation quickly become unpleasant.

However, another informant pointed out that by working continuously on the screen, more experience with the format was gained, and this led to more natural conversations when using video; this therapist described that a natural approach to working with video developed over time, making it easier to interact in this specific format.

**Coping With Technology**

Technical problems were reported as severely affecting the quality and safety of VC. One therapist who had experienced a VC in which there were numerous technical problems described the consultation as highly unsuccessful. After the consultation, this therapist felt it necessary to apologize to the service user for the poor quality of the video and the fact that they had been unable to cope with the technology.

It’s a pretty bad start when you haven’t talked to this person before, like the [VC] I mentioned, and we have to give up the consultation for technical problems. We were about to have a first consultation and then we lost 10 to 15 minutes before we found out that it did not work. What impressions are you left with then, [as a service user]? I really wonder how it was for her the first time. I wasn’t very happy after that session.

In retrospect, the therapist regrets not testing the technology before the consultation, saying: “It’s our responsibility, isn’t it? We offer a type of counseling and then we mess it up or it works badly. It is our responsibility.” This therapist was thus left feeling insufficient, that the consultation was unprofessional, and that the VC left both the therapist and the service user feeling negatively about the experience. Distortions in the picture on the screen, disruptions in the sound, losing connection, and other technological interruptions were also felt to have potentially affected the emotional connection and interrupted the flow of a vulnerable conversation. As one therapist explained:

Yes, I try, but I don’t always know where the problem lies. I am not very good with technology, so...We had a case where we had to do it over the phone. I told the [service user] that she should get help from her partner the next time, and then it worked. While with another [service user] we gave up simply because we couldn’t make [the technology] work.

VC does require a good internet connection, which not all service users and therapists have at home. When technical problems occurred, the therapists told us that their solution was to call the service user via telephone. Some therapists said they tested the technology with other colleagues before conducting the initial conversation with service users. In this way, they avoided unfavorable situations and reduced their fears of using VC. The therapists also found it essential to ensure that the service user had their technology in order and felt comfortable using it. They felt that, as professionals, they had to offer any necessary help:

For [service users] who find video technology unfamiliar and difficult to use, they can experience it as a personal failure not to master the technology. They may place the blame for the technical problems on their own incompetence, and not on the different aspects of the technology or system failures.
One informant explained that if they felt insecure about the technology, they would be fully open about it to the service user to create balance in the relationship. This would also ensure that the service user would not feel like they were to blame for the problems with the technology.

Yes, I think it is safe to say it like it is. Maybe also be a bit humble and say that you are not entirely sure of the technology yourself. There may be some connection issues, but we will solve that by calling or doing a trial round first to see if we get it right. Then we can schedule a time for a conversation maybe the next day.

Lack of Transparency: Not Knowing Who is in the Room

When a service user was in a controlling or abusive relationship, therapists found it challenging to not meet face to face in the office. The therapists explained that it could be difficult to assess with certainty whether the service user could speak openly about how they really felt and was being treated, as the person responsible for the abuse could be in the room with the service user, but off screen. The controlling or abusive partner or parent may also have the opportunity to instruct the service user on what to tell the therapist, and the therapist has no way of knowing whether the service user is being observed during the consultation. As one therapist explained:

Her partner has demanded that the conversation take place in a room that he has access to. So, when taking care of [service users] who have manipulative, controlling partners, Skype and telephone represent something I cannot handle. I also have to consider what I say to her [the service user]. If there is something she has told me when we were alone, then I cannot begin the consultation by saying, “The last time, you told me that your partner hit you.” He might be sitting right there, you know.

According to this therapist, for some service users, abuse is embedded in their everyday life, providing a clear limitation regarding what therapists may be comfortable addressing in a VC. This then leads us to the next theme, which is performing therapy on the screen.

Challenges of VC When Performing On-Screen Professional Assessment and Therapy

Suitable and Unsuitable Topics When Using Video

The therapists reported that some conditions and moods were challenging to detect through the video camera, as both body language and other nonvisual impressions disappear. Serious diagnoses and psychological investigations were mentioned as particularly difficult to conduct and discuss over video. Indeed, distrust in the technology and doubt that the VC would progress without disruptions kept many of the therapists from pursuing the most sensitive themes and subjects. They feared that the video connection would break down in the middle of a critical conversation and wanted to avoid having to ask a service user to repeat part of a longitudinal trauma monologue. The most traumatic incidents could be difficult to discuss on video for fear of technical problems or not having control over the service user’s environment. Consequently, among other reasons, the therapists did not find video to be a suitable medium for discussing service users’ most vulnerable feelings, nor was it easy to find the balance between keeping the therapy moving forward and not digging too deeply into the service users’ most vulnerable feelings or traumas. Closing the consultations also represented a potential challenge:

I think this is an important aspect, because I have no control after they leave my office. When I meet the person face to face, I have more control over my assessment of what state they are in when they leave.

One concern shared by several of the therapists centered around the challenge of knowing whether service users were left in an unresolved state and closing the consultation in an appropriate way can be challenging on the screen. A VC can be ended more abruptly than an office visit, by simply pressing the “off” button at the end of the consultation. The therapists feared that ending the conversation too rapidly could be harmful, especially if the consultation had dealt with traumatic subjects. By contrast, avoiding a long journey home by car after an emotional consultation was mentioned as a positive feature with VC, especially for service users with a commute of several hours.

VC as a Filter for Emotions and Health Conditions

Several of the therapists experienced that the video format created distance, which in turn felt like a filter or an obstacle with regard to obtaining relevant information about the service user’s condition. According to one therapist:

It gets…VC becomes like a filter between us, which, in a way maybe is more apparent on video than normally [face-to-face consultation] (…) The biggest difference is the challenge of simply understanding the nonverbal communication.

Nonverbal communication that is harder to detect on video might be a glance, a short break from the conversation while looking away, small body movements, jittery fiddling, and similar, almost invisible, movements that although sometimes hard to notice are important for the therapist’s assessment of the service user’s mental health condition. One therapist described this challenge as follows:

I am not sure how to explain it exactly, because it depends on how observant you are. You notice little things. I can listen to and observe a lot when people talk…perceive things.

This aspect of VC, in which the therapist loses information through the digital filter, was cited as the most challenging and risky part of performing consultations on the screen. One therapist had received a referral stating that a service user had a specific smell; however, because the consultation was performed over video, the therapist lost the opportunity to smell and experience the service user. The therapist explained: “There may be something about cleanliness and, what can I say, if a person does not take care of himself it can be a sign of, for example, depression.” With the digital filter in place, there is thus a risk of losing important information regarding certain health conditions, elements, and aspects that may be crucial to the therapist’s ability to see the whole picture. In complex
situations, VC did not feel like a safe alternative because of this filter and affected the therapists’ ability to make clinical judgments about the service users’ conditions. Investigating the condition of the service user through the use of standard tools, especially validated schemes to generate diagnoses, was also mentioned as challenging. Indeed, procedures such as these were largely put on hold by therapists until it was possible to meet face-to-face.

**Summary of Themes**

To summarize the findings, Table 2 includes the main themes and subthemes that emerged in the analysis.

<table>
<thead>
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<th>Theme</th>
<th>Subthemes</th>
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<td>VC promotes continuity and access to services; establishing and maintaining relationships on video</td>
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**Discussion**

**Principal Findings**

In the following, the analytic themes presented in Table 2 will be discussed. The discussion aims to highlight opportunities and challenges in the use of VC in recovery in mental health, assessment, and therapy, and to identify for whom VC worked or did not work in the short-term care pathway from the therapists’ perspective.

**“It’s Better Than Nothing”: Video Promotes Continuity and Access to Service**

There has been great concern regarding the effect that the COVID-19 restrictions, societal lockdown, and resultant social isolation will have on mental health, particularly with regard to individuals who already have mental health problems or are in a recovery process [40,41]. The use of VC enables access to mental health services, and our findings show that VC does contribute to the overall realization of the continuity and maintenance of the therapist–service user relationship [4,8,20]. Nevertheless, some therapists experienced the initiation of a relationship online to be challenging, and our findings indicate that VC cannot perfectly replace regular face-to-face meetings. This is mainly due to poor clinical quality and technical challenges, as shown in previous research [8,42]. However, from the therapists’ perspective in this study, VC was found to help create trust and confidence before the first face-to-face meeting. In some instances, VC can even increase the involvement of the service user and enhance the recovery process, similar to findings in pre-COVID-19 studies [24].

Maintaining the relationship via VC also appears to influence the identity of both the service user and the therapists. For the service user, VC may reinforce the equation of the service user and enhancement of the recovery process [8,26]. This may empower the service user if they are confident in coping with the technology, which may in turn further facilitate the recovery process.

**Life on the Screen: VC Affects the Therapists’ Work Situation**

Our findings suggest that the working conditions for therapists can change for the worse when performing VC and might cause more stress in the work situation [43]. The therapists found VC to be more exhausting than face-to-face meetings, as staring into the screen required concentration and demanded a different kind of presence than being together in the same room. As such, the consequences of implementing video technology may, in the long-term, lead to burnout for the therapists, followed by an increase in sick leave [43]. Moreover, challenges may emerge when scaling up the services after a pilot phase [32]; these may include ensuring sufficient time between each consultation on video, and that all therapists are appropriately technologically equipped [44,45]. With regard to the practical aspects of conducting an effective VC, the therapists found it especially problematic when the technology failed or worked poorly. This often interrupted the flow of communication and hampered the therapists’ efforts to foster a safe and trusting environment. The therapists expressed concern that the use of VC may be challenging for the service user and lead to a worsening of their situation. Although close relationships and support from the service user’s family may be an important part of recovery [19], for others, relationships may negatively influence the recovery process [46,47]. Service users exposed to mental abuse or mistreatment in their home environment may need an alternative to home treatment through video [19]. Similarly, children are often dependent on their parents or next of kin as facilitators when offered consultations on video [48].

**Clinical Challenges When Using Video in Consultations**

VC seems to be a workable alternative for following up with service users with less severe mental health problems; thus, depending on the service user’s specific context and state of mental health, the use of VC may be included in the process where appropriate. The therapists may also speak with the service users about which topics are suitable for VC to determine whether there are topics that should be avoided, including topics that may be too emotional for the service user to cope with.
The Future of Video Consultations in Mental Health Care

The progression of mental health care requires new ways of providing continuous follow-up in different formats based on changes in the service users’ condition and circumstances. A variety of consultation models—face-to-face meetings, video consultations, home care, cocreation meetings, and even in-hospital treatment—may be necessary to provide appropriate care. Based on an analysis of media coverage during the COVID-19 lockdown, Idland [51] argues that although VC will be used as a supplement to face-to-face consultations in the future, most people will still return to face-to-face meetings as soon as possible. The change in the numbers of VCs performed in the hospital under study reflect a similar trend: 74% of the consultations took place via video in the second part of March 2020, followed by a decrease to 21% when the restrictions were eased in May. These numbers (Table 1) are not sufficient to draw conclusions due to the short time period, but they are an indication that can be used for reflection toward the future use of VC in mental health care. The findings clearly indicate that some therapists and service users did not find VC satisfying or safe enough to replace face-to-face consultations in the long run. Further studies are needed to investigate how the use of VC can be perceived as safe and satisfying in normal situations.

Conclusions

The COVID-19 restrictions forced rapid changes in the organization of hospitals and in the treatment of different conditions in the field of mental health. This situation may represent the start of a permanent change in the way mental health services are provided. Indeed, similar changes are already recommended (and sometimes required) by the World Health Organization [52], based on a growing population struggling with mental health problems and increasing challenges regarding how to treat and reach out to those who need help. This study of therapists’ experiences with VC in a mental health hospital in Norway during COVID-19 restrictions indicates that there are overall advantages to using VC when circumstances do not permit face-to-face consultations. Although the continuity that VC offers was seen as a valuable asset, the quality of the therapy was considered to be poorer on video than in face-to-face meetings. Various negative aspects related to the therapeutic environment such as lack of safety for the most vulnerable service users and topics unsuitable for VC lowered the therapists’ overall impression of the service.

Using VC in therapy may offer opportunities for empowerment by letting the service user select VC as a medium, and may make the service more accessible and available despite physical challenges such as immobility. Access to VC is especially important considering the societal impact of COVID-19. Meeting digitally provides the opportunity to follow up with and take care of the service user’s needs. A range of potential advantages appear when transferring parts of the mental health services into digital services and increasing the use of VC, including increased number of service users in treatment, increased satisfaction of both service users and therapists, improved outcomes, destigmatization, and more direct time expenditure on care by the therapists.

Strengths and Limitations of the Study and Issues for Further Research

This study was performed within the context of COVID-19 restrictions, during which the entire department was required to use VC to maintain the treatment of service users in recovery. This allowed access to therapists with both negative and positive perceptions and experiences of digital communication therapy, avoiding the challenge of biased data from digital pioneers. A potential weakness of the study is its reliance on digital interviews. As demonstrated in this study, communicating via video can create a filter and a distance between the actors involved; as such, the information derived from the interviews may have been different if the interviews had been conducted face-to-face.

There is a need for further investigation, including qualitative research, to build solid and evidence-based knowledge that can contribute to developing tailored services for people in recovery and in need of mental health care. Further research should focus on service users’ experiences; cocreation between different stakeholders; and how to scale up the use of VC while ensuring that the service provided is appropriate, safe, and available.

Acknowledgments

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Conflicts of Interest
None declared.

References


Abbreviations

- eHealth: electronic health
- EPJ: electronic patient journal
- VC: video consultation

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Barriers to the Use of Clinical Decision Support for the Evaluation of Pulmonary Embolism: Qualitative Interview Study

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Abstract

Background: Clinicians often disregard potentially beneficial clinical decision support (CDS).

Objective: In this study, we sought to explore the psychological and behavioral barriers to the use of a CDS tool.

Methods: We conducted a qualitative study involving emergency medicine physicians and physician assistants. A semistructured interview guide was created based on the Capability, Opportunity, and Motivation-Behavior model. Interviews focused on the barriers to the use of a CDS tool built based on Wells’ criteria for pulmonary embolism to assist clinicians in establishing pretest probability of pulmonary embolism before imaging.

Results: Interviews were conducted with 12 clinicians. Six barriers were identified, including (1) Bayesian reasoning, (2) fear of missing a pulmonary embolism, (3) time pressure or cognitive load, (4) gestalt includes Wells’ criteria, (5) missed risk factors, and (6) social pressure.

Conclusions: Clinicians highlighted several important psychological and behavioral barriers to CDS use. Addressing these barriers will be paramount in developing CDS that can meet its potential to transform clinical care.

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KEYWORDS
medical informatics; pulmonary embolism; electronic health records; quality improvement; clinical decision support systems

Introduction

Clinicians often disregard potentially beneficial clinical decision support (CDS) tools. Extensive study of these tools has shown that their use is associated with a morbidity reduction of 10% to 18%, placing CDS at the top of the spectrum of quality improvement interventions [1]. Improvements in quality of care observed with CDS use [2-8] have been significantly limited by consistently low clinician adoption, estimated at 10% [9,10]. CDS based on Wells’ criteria for pulmonary embolism [11] serves as an illustration of this phenomenon. Systematic reviews have shown that the use of these criteria decreases ordering of computed tomography (CT) scans by 25% without resulting in additional missed pulmonary emboli (PEs) by clinicians [12]. However, clinicians have requested the removal of CDS tools based on these criteria, even when local efficacy has been demonstrated [13].

A systematic review of 58 studies evaluating barriers to clinician adoption of CDS classified these as “CDS specific, organizational, patient and clinician factors” [14]. CDS-specific factors included those that would improve the ease of tool use (ie, minimal mouse clicks, workflow integration). Organizational factors focused on infrastructure and technical issues (ie, having enough computers). Patient factors focused on clinician perceptions of the impact of CDS on the patient-clinician relationship (ie, CDS diminishes the relationship by distracting
The clinician). Clinician factors focused on clinician attitudes toward CDS, including a preference for intuitive thought and perception of CDS as a threat to professional autonomy. Clinician attitudes toward CDS, including psychological and behavioral barriers, are not typically addressed during any stage of CDS development although they represent an important barrier to adoption.

Several important publications have detailed the many challenges to CDS reaching its full potential [15], guiding principles for effective CDS [16] and barriers to guideline concordant care and successful implementation of CDS [17-19]. However, improved understanding of the psychological and behavioral barriers to clinician use of potentially transformative CDS tools would assist developers in creating highly adopted, high-impact tools. We sought to explore these barriers by using a comprehensive behavioral framework to interview users of a CDS tool based on Wells’ criteria for pulmonary embolism [20].

**Methods**

**Study Design**

We conducted a qualitative study involving emergency medicine physicians (residents and attendings) and physician assistants at two large academic health care facilities in New York. The Northwell Health Institutional Review Board approved this study. Informed consent was obtained for all participants. Participants were recruited by email and presentation at regular faculty meetings. Interviews were conducted between June and September of 2019, and each interview lasted from 30 minutes to 1 hour.

**Interview Guide and Behavioral Framework**

In-depth interviews focused on the different barriers to use of a CDS tool built based on Wells’ criteria for pulmonary embolism to assist clinicians in establishing pretest probability of PE before imaging. A semistructured interview guide was created based on a comprehensive and parsimonious model of behavior—the Capability, Opportunity, Motivation-Behavior (COM-B) model, which specifies that changing behavior requires changing capability, opportunity, and/or motivation [21]. The COM-B model is at the center of a larger behavioral framework—the Behavior Change Wheel. The Behavior Change Wheel was developed from 19 existing behavioral frameworks and includes 9 intervention functions aimed at addressing deficits in one or more of the conditions described by the COM-B model.

**CDS Tool**

The tool was designed to reduce unnecessary computed tomography pulmonary angiography (CTPA) ordering. Additional details about the design, implementation and evaluation of the tool are available in a previous publication [20]. Emergency clinicians entering any electronic order for the diagnosis of PE (D-dimer, ventilation–perfusion [V/Q] scan, or CTPA) are routed to the tool if they answer “yes” to a dialog box asking, “Are you considering PE?” The tool functions as an expanded order set that allows clinicians to formally calculate pretest probability of PE according to Wells’ criteria. For low-risk patients, it only allows clinicians to order D-dimer laboratory testing and for patients with intermediate or high risk of PE, it allows for D-dimer testing, V/Q scan, or CTPA imaging. At any time, the tool can be dismissed by clinicians and then any order can be placed. The tool was developed using adaptive principles in web and health information technology design, which have been detailed in several previous publications [22-25]. The current version of the tool has been active since January 2016 [24]; all study participants had previously used the tool in clinical practice.

**Analysis**

Thematic saturation was reached after the twelfth interview, with no new insights obtained by the twelfth participant. The COM-B model informed the development of the interview guide, but it was not used to create a priori themes before qualitative analysis. Inductive methods were used to analyze session notes and audio recordings with the COM-B model as a guiding theory. We identified themes using open and then axial coding, and we coded our data accordingly using the qualitative data analysis software NVivo (version 12, released 2018; QSR International Pty Ltd.). Two members (SR and KLD) of the study team, with experience conducting qualitative analysis, coded all sessions. All discrepancies were resolved by consensus.

**Results**

Interviews were conducted with 5 resident physicians, 5 attending physicians, and 2 physician assistants. Six major barriers to tool use were identified, including (1) Bayesian reasoning, (2) fear of missing a PE, (3) time pressure or cognitive load, (4) gestalt includes Wells’ criteria, (5) missed risk factors, and (6) social pressure (Table 1).
Clinicians highlighted the belief that the tool was not useful to them because all elements of Wells’ criteria for pulmonary embolism were incorporated into their gestalt. The clinical prediction rule is well known and commonly taught during training in emergency medicine. Fear of missing PE was another major theme identified in our analysis. Patient health consequences were rarely mentioned. Clinicians felt that missed PEs were likely to be less clinically significant and unlikely to result in significant harm to patients, but they worried they still might trigger department quality improvement review or legal action. Time pressure was also highlighted as a major barrier to tool use. Although clinicians denied that cognitive load kept them from using the tool, the majority of clinicians spontaneously mentioned their preference for the pulmonary embolism rule-out criteria (PERC) owing to its simplicity. PERC is validated for use in low-risk patients to rule out PE if eight criteria are negative [26].

Additional themes included Bayesian reasoning, missed risk factors, and social pressure. Bayesian reasoning reflected some clinicians not recalling that the posttest probability of PE would be impacted by the pretest probability of PE, predicted by the CDS, regardless of the results of the CT scan. Missed risk factors reflected clinicians’ mistrust of the CDS as Wells’ criteria for pulmonary embolism do not explicitly include a few known risk factors for PE. Social pressure reflected many clinicians’ report that other members of the care team, including the patient and their primary care doctor, could influence their decision to not use or not follow the recommendation of the tool.

**Discussion**

**Principal Findings**

In this qualitative study of barriers to the use of CDS for the evaluation of PE, participants reported that the CDS tool was not useful to them despite decades of research validating the efficacy of the clinical prediction rule that served as the basis for the tool and our work showing that tool users at our institution improved their CT scan ordering behaviors [20]. Most clinicians felt that they were able to incorporate the elements of the Wells’ criteria for pulmonary embolism into their decision-making without using the tool. The clinical prediction rule, with seven elements, each weighted differently, is complicated enough to make memorization unreliable. There is evidence that clinicians have trouble remembering even simple clinical prediction rules. For example, a study in which clinicians were surveyed about their knowledge of the Ottawa Ankle Rule found that although 89.6% reported using the rule always or most of the time in appropriate circumstances, only 30.9% correctly remembered which four components were part of the rule [27].

Another major barrier to tool use was fear of missing a PE. In a previous study, surveyed emergency medicine clinicians said that about one-fifth of all imaging studies ordered were medically unnecessary [28]. The main perceived contributors were fear of missing a low-probability diagnosis and fear of litigation. Interestingly, although many clinicians in our study reported this as a barrier, only one knew of any emergency medicine clinician who had ever been sued for a missed PE. The great majority of patients in New York who sustain a medical injury because of negligence do not sue [29,30], and...
Evidence of adherence to known clinical practice guidelines can help clinicians avoid liability [31]. More importantly, systematic reviews have shown that the use of the Wells’ criteria for pulmonary embolism decreases CT scan ordering by 25% without resulting in additional missed PEs by clinicians [12]. These facts were not unknown to clinicians in our study, and many volunteered similar statements. However, these facts alone were not enough to address this important psychological barrier to tool use.

Psychological and behavioral barriers, such as gestalt includes Wells’ criteria and fear of missing PE, as well as time pressure or cognitive load are not easily addressed by educational quality improvement interventions. Emergency medicine clinicians are familiar with and believe the Wells’ criteria for pulmonary embolism is useful, as evidenced by a study which surveyed clinicians at our institution [32]. Additionally, the benefits of using the CDS tool, which incorporates these criteria, were reviewed in several academic detailing training sessions for the tool with clinicians before its launch [20]. Additional educational sessions would not be likely to address the sense for physicians that their gestalt adequately considers Wells’ criteria for pulmonary embolism without referencing them. This is likely to be the case as well for using educational sessions or traditional CDS to reduce fear of missing PE.

Time pressure or cognitive load may be the most difficult to address and an important barrier to the use of CDS in the emergency department. However, clinicians reported that low utility was the driving factor for dismissal, and not cognitive load or time. They also reported the importance of eliminating even a single extra click and a strong preference for PERC owing to its simplicity; however, unlike the Wells’ criteria for pulmonary embolism, it can only be used in low-risk patients. Additionally, emergency medicine may be the clinical specialty with the highest task load and one of the highest cognitive loads [33]. This demanding environment exerts strong pressure on clinicians to find the fastest, safest path forward. In the case of assessment for PE, this often means skipping the CDS and ordering a CTPA—the definitive test to evaluate for PE.

Some of the barriers identified by this study, such as Bayesian reasoning and missed risk factors, might be addressed by simple educational quality improvement interventions. Addressing common knowledge gaps with education—that is, the role of Bayesian reasoning and instances when the rule is not valid—may help to increase adoption rates. A recent study of guideline-discordant CT scans performed to evaluate for PE found that in 39% of these cases, patients had risk factors that were not explicitly incorporated in traditional clinical prediction rules [34]. Building tools with brief instruction manuals may help clarify for clinicians when to use and when not to use these tools. Additionally, although educational quality improvement interventions would be less likely to address barriers such as gestalt includes Wells’ criteria, fear of missing PE, and time pressure or cognitive load, there are several behavioral interventions that might move the needle. For example, tool endorsement by key leadership might increase use, by communicating institutional backing for tool use and mitigating the fear of missing PE. Avenues to address the social pressure barrier would need to be informed by further research, for example, by knowledge of study patients and their preferences.

We have shown how a behavioral model can identify novel barriers to the adoption of a CDS tool. Our findings underscore the importance of addressing the psychological and behavioral barriers to CDS use. Although the field stands to benefit greatly from much anticipated advances in computational capabilities—for example, artificial intelligence, including machine learning—these tools are unlikely to meet their potential to transform clinical care until behavioral barriers to their use are adequately described and addressed.

Limitations
Our work has several limitations. All clinicians work in the New York City metropolitan area. Both institutions are academic tertiary care centers. Clinicians outside of this geographical area or working in community hospital settings were not included in this study.

Conclusions
In summary, clinicians highlighted several important psychological and behavioral barriers to CDS use. Addressing these barriers will be paramount in developing CDS that can meet its potential to transform clinical care.

Acknowledgments
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Conflicts of Interest
None declared.

References


Abbreviations

CDS: clinical decision support
COM-B: Capability, Opportunity, and Motivation-Behavior
CT: computed tomography
CTPA: computed tomography pulmonary angiography
PE: pulmonary embolism
PERC: pulmonary embolism rule-out criteria
V/Q: ventilation–perfusion
Abstract

Background: Transparency is increasingly called for in health care, especially when it comes to patients’ access to their electronic health records. In Sweden, the e-service Journalen is a national patient accessible electronic health record (PAEHR), accessible online via the national patient portal. User characteristics and perceived benefits of using a PAEHR influence behavioral intention for use and adoption, but poor usability that increases the effort expectancy can have a negative impact. It is, therefore, of interest to explore how users of the PAEHR Journalen perceive its usability and usefulness.

Objective: The aim of this study was to explore how the users of the Swedish PAEHR experience the usability of the system and to identify differences in these experiences based on the level of transparency of the region.

Methods: A survey study was conducted to elicit opinions and experiences of patients using Journalen. The data were collected from June to October 2016. The questionnaire included questions regarding the usability of the system from the System Usability Scale (SUS). The SUS analysis was the focus of this paper. Analysis was performed on different levels: nationally looking at the whole data set and breaking it down by focusing on 2 different regions to explore differences in experienced usability based on the level of transparency.

Results: During the survey period, 423,141 users logged into Journalen, of which 2587 unique users completed the survey (response rate 0.61%). The total mean score for all respondents to the SUS items was 79.81 (SD 14.25), which corresponds to a system with good usability. To further explore whether the level of transparency in a region would affect the user’s experience of the usability of the system, we analyzed the 2 regions with the most respondents: Region Uppsala (the first to launch, with a high level of transparency), and Region Skåne (an early implementer, with a low level of transparency at the time of the survey). Of the participants who responded to at least 1 SUS statement, 520 stated that they had received care in Region Skåne, whereas 331 participants had received care in Region Uppsala. Uppsala’s mean SUS score was 80.71 (SD 13.41), compared with Skåne’s mean of 79.37 (SD 13.78).

Conclusions: The Swedish national PAEHR Journalen has a reasonably good usability (mean SUS score 79.81, SD 14.25); however, further research into more specific usability areas are needed to ensure usefulness and ease of use in the future. A somewhat higher SUS score for the region with high transparency compared with the region with low transparency could indicate a relationship between the perceived usability of a PAEHR and the level of transparency offered, but further research on the relationship between transparency and usability is required.

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KEYWORDS

usability; system usability scale; evaluation; patient accessible electronic health records; open notes; patient portals
**Introduction**

Transparency, including the possibility for patients to gain insight into one’s own medical information, is increasingly called for in health care, especially, when it comes to patients’ access to their electronic health records (EHRs) [1]. Many countries (eg, Finland, France, Norway, Australia, Denmark, Canada, United Kingdom, and Sweden) have, in the past, implemented or are now currently implementing patient accessible electronic health records (PAEHRs) [2]. In some countries, these are local implementations at a specific hospital or region, whereas others have national solutions. Differences in strategies and approaches have affected the uptake and impact, and the implementation progress has, in several countries, been slow due to legal constraints [3,4] and concerns about security and privacy among health care professionals [5-7]. A PAEHR often includes the clinical notes written by different health care professionals, as well as other parts of the EHR (eg, lab results, referrals, and medications).

In the United States, the OpenNotes initiative focuses on providing patients access to their notes, specifically. OpenNotes began as a pilot evaluation project that included 105 volunteer primary care physicians and their 19,000 patients [8,9]. The initiative started in 2010 and has since spread throughout the United States [10]. On April 5, 2021, a new federal rule required US health care providers to allow patients access to all the health information in their EHR [11,12]. This new rule mandates rapid, full access to test results, medication lists, referral information, and clinical notes in electronic formats, by request.

In Sweden, the e-service Journalen is a national PAEHR, accessible online via the national patient portal called 1177.se [13]. The PAEHR service accesses the EHR information from most of the various EHR systems used throughout Swedish health care organizations, via a national health information exchange platform [14,15]. Hence, patients have one access point for all their health record information regardless of (1) how many health care providers they have visited and (2) which EHR system their health care providers use [13]. Since the first Swedish region began providing their inhabitants online access to their health records in 2012, all the other regions have connected to the national infrastructure and the PAEHR Journalen. This was not the case from the beginning, though, and the last of the 21 regions connected only in April 2018. In addition, different regions made different choices about how much of their information would be made available to patients; for example, patients receiving care in one region could gain access to both their lab results and notes, whereas patients receiving care in a different region might only be able to access the notes [13,16].

A growing literature on patients’ experiences of accessing their records online reports positive outcomes [10,16]. Patients who read their notes have reported a better understanding of their care plans [10], a sense of greater control over their care [10,16], an improved adherence to medication [17], improved communication with and trust in their clinicians [16,17], and a sense that their care is safer [18].

Despite these benefits, adoption and use can be low [19], and several studies have explored factors that influence adoption [20,21]. User characteristics and perceived benefits of using a PAEHR might influence behavioral intention for use and adoption, but poor usability that increases the effort expectancy can also have an impact. It is, therefore, of interest to further explore how users of the PAEHR Journalen perceive its usability and usefulness; the latter is especially important, considering the differences in the levels of transparency regarding patients’ health information in different regions.

In this study, we analyzed data on usability issues from a national survey conducted among patients who use the PAEHR Journalen. A first analysis of the main results from the survey was published in 2018 [16] and contains an overview of the full survey. Here, we focused only on the usability-related questions as well as some demographic data of the participants. At the time of the study (June to October 2016), not all regions allowed patients access to their records through Journalen, and, among those who did, the level of transparency of this information varied [16]. Table 1 represents an overview of what types of clinical content the health care providers had chosen to allow access to at the time of data collection for this study.

The aim of this study was to explore how the users of the Swedish PAEHR experience the usability of the system and to identify differences in these experiences based on the level of transparency regarding patients’ health information for the region.
Table 1. Overview of core types of clinical content the health care providers (21 regions and 1 private care provider) had chosen to allow access to at the time of data collection for this study (adapted from [16]).

<table>
<thead>
<tr>
<th>Care provider</th>
<th>Content provided</th>
<th>Total content available</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medical notes</td>
<td>Diagnoses</td>
</tr>
<tr>
<td></td>
<td>(18/22, 82%)</td>
<td>(15/22, 68%)</td>
</tr>
<tr>
<td>Blekinge</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Dalarna</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Gotland</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Gävleborg</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Halland</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Jämtland/ Härjedalen</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Jönköping</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Kalmar</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Kronoberg</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Norrbotten</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Skåne</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Stockholm</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Södermanland</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Uppsala</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Värmland</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Västerbotten</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Västernorrland</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Västmanland</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>VGR</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Örebro</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Östergötland</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Capio (private care provider)</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Methods

Study Design
A survey study was conducted to collect opinions and experiences of patients using Journalen. The data were collected from June to October 2016, after ethical approval of the research was granted by the Regional Ethical Review Board in Uppsala, Sweden (EPN 2016/129). Participants were recruited through the national PAEHR Journalen. When patients logged into Journalen, they received a request for voluntary survey participation together with information about the study. Thus, only active users of Journalen were invited to participate.

Data Collection

Survey Preparation
An anonymous questionnaire was designed covering different topic areas with a total of 24 questions in Swedish (see the full questionnaire in [16]), including questions regarding the usability of the system using the System Usability Scale (SUS) [22].

The usability and technical functionality of the electronic questionnaire had not been tested before fielding the questionnaire. However, participants received information about whom to contact in case of technical issues. The SUS has been validated and used in many studies [23].

The collected data were managed by the eHealth service provider Inera AB, in accordance with the Regional Ethical Review Board's approval. The survey data were stored in the same database system as the PAEHR Journalen, meaning that the collected data, including patient IDs, had the same security protection as all patient information handled in the PAEHR. A patient ID was stored during the collection period to ensure that patients had not left duplicate responses. When the collection period was completed, the patient ID was removed and all stored information was anonymized. The anonymized dataset was exported to researchers for analysis.
**The System Usability Scale**

The SUS [22] is a simple, 5-point Likert scale that provides a global view of subjective assessments of usability, which was developed as a fast and efficient method to collect an overview of the usability of a system [24]. Benefits of the SUS tool include that it is technologically agnostic (i.e., it can be used for many different types of information technology systems), that it is quick and easy to use for both participants and researchers, that it provides a single score on a scale that is easy to understand, and that it is cost efficient due to its state of nonpropriety [24]. The SUS consists of 10 statements that were slightly modified and translated to Swedish for this study (Table 2).

### Table 2. The System Usability Scale statements\(^a\) and our modifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>SUS(^b) statement</th>
<th>Modified statement</th>
<th>Statement in Swedish</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I think that I would like to use this system frequently.</td>
<td>I think that I would like to use Journalen regularly.</td>
<td>Jag tror att jag vill använda ”Journalen” regelbundet.</td>
</tr>
<tr>
<td>2</td>
<td>I found the system unnecessarily complex.</td>
<td>I found Journalen unnecessarily complex.</td>
<td>Jag anser att ”Journalen” är mer komplicerad än vad den behöver vara.</td>
</tr>
<tr>
<td>3</td>
<td>I thought the system was easy to use.</td>
<td>I thought Journalen was easy to use.</td>
<td>Jag anser att ”Journalen” är lätt att använda.</td>
</tr>
<tr>
<td>4</td>
<td>I think that I would need the support of a technical person to be able to use this system.</td>
<td>I think that I would need the support of a technical person to be able to use Journalen.</td>
<td>Jag tror att jag skulle behöva personlig teknisk support för att kunna använda ”Journalen.”</td>
</tr>
<tr>
<td>5</td>
<td>I found the various functions in this system well integrated.</td>
<td>I found the various functions in the system well integrated.</td>
<td>Jag anser att de olika funktionerna i ”Journalen” fungerar väl tillsammans.</td>
</tr>
<tr>
<td>6</td>
<td>I thought there was too much inconsistency in this system.</td>
<td>I thought there was too much inconsistency in this system.</td>
<td>Jag anser att det finns många delar i ”Journalen” som inte är konsekventa.</td>
</tr>
<tr>
<td>7</td>
<td>I would imagine that most people would learn to use this system very quickly.</td>
<td>I would imagine that most people would learn to use Journalen very quickly.</td>
<td>Jag tror att de flesta skulle kunna lära sig att använda ”Journalen” ganska snabbt.</td>
</tr>
<tr>
<td>8</td>
<td>I found the system very cumbersome to use.</td>
<td>I found Journalen very cumbersome to use.</td>
<td>Jag anser att ”Journalen” är besvärlig att använda.</td>
</tr>
<tr>
<td>9</td>
<td>I felt very confident using the system.</td>
<td>I felt very confident using Journalen.</td>
<td>Jag känner mig väldigt säker och trygg (på vad jag gör) när jag använder ”Journalen.”</td>
</tr>
<tr>
<td>10</td>
<td>I needed to learn a lot of things before I could get going with this system.</td>
<td>I needed to learn a lot things before I could get going with Journalen.</td>
<td>Jag behöver lära mig ganska mycket innan jag kan börja använda ”Journalen.”</td>
</tr>
</tbody>
</table>

\(^a\)Responses were measured with a 5-point Likert scale.

\(^b\)SUS: System Usability Scale.

### Data Analysis

#### Main Analyses

Overall, 2587 patients from 21 regions completed the survey. The number of participants for each region varied. Notably, it was not possible to statistically verify whether the number of participants was at an adequate level to provide more than tentative region-wise and group-wise comparisons. Only completed questionnaires have been analyzed, as the answers were stored in the database only when the participant chose to submit the survey on the last page. However, the SUS items were not mandatory to respond to, and, therefore, the total number of answers for each SUS item varied (Table 3). In addition, 48 participants did not answer any of the SUS items and were excluded from further analysis, leaving 2539 people who answered at least 1 SUS item. Item 1 had the most answers (n=2507), whereas item 6 had the fewest (n=2459). Some free-text comments also indicated that item 6 was difficult to understand for some of the participants.

Rather than excluding questionnaires with missing SUS answers, we have chosen to substitute a neutral (e.g., “neither agree nor disagree”) response for the missing items. Since individual items on the SUS score are not necessarily meaningful themselves, this was a feasible approach to make sure that we did not tilt the results to one of the extremes when simply excluding a response.

In this paper, we focused on the SUS questions, which were analyzed according to the SUS method. Questions regarding demographics and perceived usefulness were also included in the analysis (for these questions, we used all survey responses, not excluding those who did not respond to the SUS statements). The analysis was completed on different levels: (1) nationally looking at the whole data set and (2) breaking it down by focusing on 2 different regions to explore differences in experienced usability based on the level of transparency. The 2 different regions were Upplands (the first to launch, with a high level of transparency), and Skåne (an early implementer, with a low level of transparency at the time of the survey).
Table 3. The number of answers for each System Usability Scale item (N=2539).

<table>
<thead>
<tr>
<th>Item</th>
<th>Modified SUS\textsuperscript{a} item</th>
<th>Total answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I think that I would like to use Journalen regularly.</td>
<td>2507</td>
</tr>
<tr>
<td>2</td>
<td>I found Journalen unnecessarily complex.</td>
<td>2476</td>
</tr>
<tr>
<td>3</td>
<td>I thought Journalen was easy to use.</td>
<td>2498</td>
</tr>
<tr>
<td>4</td>
<td>I think that I would need the support of a technical person to be able to use Journalen.</td>
<td>2471</td>
</tr>
<tr>
<td>5</td>
<td>I found the various functions in the system were well integrated.</td>
<td>2481</td>
</tr>
<tr>
<td>6</td>
<td>I thought there was too much inconsistency in this system.</td>
<td>2459</td>
</tr>
<tr>
<td>7</td>
<td>I would imagine that most people would learn to use Journalen very quickly.</td>
<td>2479</td>
</tr>
<tr>
<td>8</td>
<td>I found Journalen very cumbersome to use.</td>
<td>2462</td>
</tr>
<tr>
<td>9</td>
<td>I felt very confident using Journalen.</td>
<td>2482</td>
</tr>
<tr>
<td>10</td>
<td>I needed to learn a lot things before I could get going with Journalen.</td>
<td>2448</td>
</tr>
</tbody>
</table>

\textsuperscript{a}SUS: System Usability Scale.

\textbf{SUS Analysis}

We decided to include all the answers to the SUS items in our calculation, in which participants responded to at least one SUS item, despite some participants not answering all items. We calculated the individual analysis for each participant’s SUS score, and the median and mean values for the entire population. The final scores for the SUS can range from 0 to 100, where higher scores indicate better usability. Because the statements alternate between positive and negative, care must be taken when scoring the survey. To calculate the SUS score, each item’s score contribution (ranging from 0-4) must be calculated. For items 1, 3, 5, 7, and 9, the score contribution is the scale position minus 1. For items 2, 4, 6, 8, and 10, the contribution is 5 minus the scale position. For participants who missed 1 or more SUS question, we chose to substitute a neutral (“neither agree nor disagree”) response for missing items.

The score contributions for each item were then added together and multiplied by 2.5 to achieve the final score [22]. According to Bangor and colleagues' [24] thorough evaluation of the SUS, a system needs to score above 70 to be considered at least passable. Better systems will score in the high 70s to high 80s, and scores over 90 indicate a truly superior system [24]. The authors also argued that any system that scores below 70 would require further usability testing and continued improvement.

We made 3 separate SUS calculations: (1) a calculation of all the individual answers, (2) a calculation of only answers from participants from Uppsala, and (3) a calculation of only answers from participants from Skåne.

\textbf{Results}

During the survey period, 423,141 users logged into Journalen, of which 2587 patients completed the survey (of unique users that logged in, response rate 0.61%). Of all respondents, 62.97% (1629/2587) identified as women and 30.85% (798/2587) as men; 0.39% (10/2587) of respondents chose “other,” and 5.80% (150/2587) did not answer this question. According to use statistics provided by Inera AB (the company providing Journalen and the national patient portal [25]), this reflects the gender distribution of the users in general (in 2016, 60% women and 40% men). Of all respondents, 39.81% (1030/2587) stated that they were working or had been working within health care, and 54.54% (1411/2587) stated that they had no professional relation to health care; 5.64% (146/2587) of respondents did not answer this question. Participants had a higher education level than the general population [16]. Among our participants, 60.57% (1487/2455) had higher education, whereas only 42% of the general Swedish population does [26]. We cannot tell whether this is because users of Journalen are well educated or that people with a higher education represent a subgroup of users who are more inclined to answer a survey. Unfortunately, no data on the general education levels of Journalen users exist.

To sum up, the survey results regarding user characteristics on a national level indicate that most participants were women and that the majority had studied at least 3 years of higher education. In addition, results indicate that many users of Journalen were both patients and medical professionals, at various points in their lives.

In Moll and colleagues’ [16] overview of the survey results, details of the participants’ views of the usefulness and benefits of accessing their health records online are presented in more detail. Overall, patients who answered the survey were positive toward Journalen (Table 4). Participants were asked to rate on a 5-point Likert scale to what extent they agreed to the more general statements, “I think that access to one’s medical records online is generally a good reform,” and “I think that access to Journalen is good for me.” Of all participants, >96% (2454/2541, 96.58% and 2455/2528, 97.11%, for the respective questions) had a positive attitude toward Journalen, answering with either “completely agree” or “partly agree.”
Table 4. Participants’ attitudes toward patients’ access to their medical records online.

<table>
<thead>
<tr>
<th>Item</th>
<th>Value, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I think access to one’s medical records online is generally a good reform.</td>
<td>2541\textsuperscript{a}</td>
</tr>
<tr>
<td>Do not agree at all</td>
<td>26 (1.02)</td>
</tr>
<tr>
<td>Do not agree</td>
<td>23 (0.91)</td>
</tr>
<tr>
<td>Neutral</td>
<td>38 (1.50)</td>
</tr>
<tr>
<td>Partly agree</td>
<td>302 (11.89)</td>
</tr>
<tr>
<td>Completely agree</td>
<td>2152 (84.69)</td>
</tr>
<tr>
<td>I think that access to Journalen is good for me.</td>
<td>2528\textsuperscript{a}</td>
</tr>
<tr>
<td>Do not agree at all</td>
<td>19 (0.75)</td>
</tr>
<tr>
<td>Do not agree</td>
<td>15 (0.59)</td>
</tr>
<tr>
<td>Neutral</td>
<td>39 (1.54)</td>
</tr>
<tr>
<td>Partly agree</td>
<td>199 (7.87)</td>
</tr>
<tr>
<td>Completely agree</td>
<td>2256 (89.24)</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Some participants did not answer all questions. Therefore, the total for each variable category differs.

However, a positive attitude toward accessing one’s health records does not say much about the usability of the system, and, therefore, we also present the results of the SUS analysis. Results of the analysis of the SUS questions are first described on a national level. Table 5 presents the results of all participants for the SUS items in the survey, including neutral responses replacing missing answers for participants who responded to at least 1 SUS item.

Table 5. Results of the System Usability Scale items for all participants, on a national level (N=2539)\textsuperscript{a}.

<table>
<thead>
<tr>
<th>SUS\textsuperscript{b} analysis item</th>
<th>Value per 5-point Likert scale response\textsuperscript{c}, n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>I think that I would like to use Journalen regularly.</td>
<td>37 (1.46)</td>
</tr>
<tr>
<td>I found Journalen unnecessarily complex.</td>
<td>915 (36.04)</td>
</tr>
<tr>
<td>I thought Journalen was easy to use.</td>
<td>40 (1.58)</td>
</tr>
<tr>
<td>I think that I would need the support of a technical person to be able to use Journalen.</td>
<td>1843 (72.59)</td>
</tr>
<tr>
<td>I found the various functions in the system were well integrated.</td>
<td>62 (2.44)</td>
</tr>
<tr>
<td>I thought there was too much inconsistency in this system.</td>
<td>550 (21.66)</td>
</tr>
<tr>
<td>I would imagine that most people would learn to use Journalen very quickly.</td>
<td>29 (1.14)</td>
</tr>
<tr>
<td>I found Journalen very cumbersome to use.</td>
<td>1587 (62.50)</td>
</tr>
<tr>
<td>I felt very confident using Journalen.</td>
<td>54 (2.13)</td>
</tr>
<tr>
<td>I needed to learn a lot things before I could get going with Journalen.</td>
<td>1790 (70.50)</td>
</tr>
</tbody>
</table>

\textsuperscript{a}The appropriate number of neutral responses were added to replace missing responses for each item, in order to not skew results due to missing items.

\textsuperscript{b}SUS: System Usability Scale.

\textsuperscript{c}From 1 (“Do not agree at all”) to 5 (“Completely agree”).

For all participants, the total mean score for the SUS scale was 79.81 (SD 14.25), which would, according to Bangor and colleagues [24], qualify as a successful system. The median score was 82.5, and the distribution of individual answers is plotted in Figure 1. The scores covered the entire range, from 0 (1 person) to 100 (158 people), but the majority of individuals scored above 60.
Each item can have a score contribution between 0 and 4. Most of the items scored above 3; however, 3 questions stood out with score contributions below 3 (Table 6). All 3 questions that scored below 3 related to the complexity of the system and whether functions are well integrated in the system.

Table 6. System Usability Scale score contribution of individual items.

<table>
<thead>
<tr>
<th>SUS analysis item</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I think that I would like to use Journalen regularly.</td>
<td>3.54</td>
</tr>
<tr>
<td>I found Journalen unnecessarily complex.</td>
<td>2.85</td>
</tr>
<tr>
<td>I thought Journalen was easy to use.</td>
<td>3.32</td>
</tr>
<tr>
<td>I think that I would need the support of a technical person to use Journalen.</td>
<td>3.55</td>
</tr>
<tr>
<td>I found the various functions in the system were well integrated.</td>
<td>2.81</td>
</tr>
<tr>
<td>I thought there was too much inconsistency in this system.</td>
<td>2.42</td>
</tr>
<tr>
<td>I would imagine that most people would learn to use Journalen very quickly.</td>
<td>3.10</td>
</tr>
<tr>
<td>I found Journalen very cumbersome to use.</td>
<td>3.38</td>
</tr>
<tr>
<td>I felt very confident using Journalen.</td>
<td>3.42</td>
</tr>
<tr>
<td>I needed to learn a lot things before I could get going with Journalen.</td>
<td>3.53</td>
</tr>
</tbody>
</table>

To further explore whether the level of transparency in a region would affect the user’s experience of the usability of the system, we made additional SUS analyses based on the 2 regions with the most participants: Region Uppsala (the first to launch, with a high level of transparency) and Region Skåne (an early implementer, with a low level of transparency at the time of the survey). Overall, 692 participants stated that they had received care in Region Skåne, of which 520 responded to at least 1 SUS item and were included in this analysis. However, 520 participants stated that they had received care in Region Uppsala, of which 331 had responded to at least 1 SUS item. Analysis of Region Skåne responses yielded a final score of 79.37, whereas Uppsala’s result was 80.71. The results in mean SUS score were close enough to indicate that no major
Discussion

To summarize, the results indicate that the users of the Swedish PAEHR Journalen rate the service high (79.81) on the System Usability Scale, yet questions relating to consistency and complexity scored lower. Before discussing the results in more detail, we address some methodological limitations of this study.

The System Usability Scale

The SUS does not help identify specific usability issues or provide detailed information on effectiveness or efficiency of the system that is evaluated. For an in-depth usability evaluation, usability testing or other forms of usability evaluations would be necessary. However, to gain an overall understanding of the level of usability of a system, the SUS can be useful [24]. In this study, we chose to use SUS items as parts of a more extensive survey to achieve an overall understanding of the usability of the current version of the Swedish PAEHR Journalen. An SUS score could also be used as a baseline analysis for further evaluations of the PAEHR, particularly, when changes to PAEHR’s user interface or content have been implemented.

Limitations of the Survey

The survey distribution may have created a bias in the study, which needs to be considered when interpreting the results. The survey was distributed through the national patient portal and was only accessible once someone logged into Journalen. This was intentional, as the main aim of the study was to explore the experiences of people who had used the e-service. This does, however, mean that only users with the skills and competence to access Journalen were able to answer the survey. If we, instead, had recruited people to represent the entire Swedish population, the results may have been different. In addition, a user who had previously tried using Journalen but did not find it very useful or usable might not have returned at all and would therefore not have found the survey. Hence, our results are likely biased toward more positive users.

In addition, it is not possible to determine whether the participants of our survey are representative of all users of Journalen. As in most survey studies, the participants form a small sample of all possible users, and many more users than those who answered the survey logged into Journalen during the 5 months that the survey was open. We do not know whether the demographic distribution is representative. Our survey participants have a higher education level than the general population, but, unfortunately, we do not know the education levels of all Journalen users. Among our participants, 60.57% (1487/2455) had higher education, whereas only 42% of the general Swedish population does [26]. We cannot tell whether this is because users of Journalen are typically well educated; it may also be that the well-educated users are more likely to answer a survey. An interesting future study would be to explore further whether user education level and eHealth literacy would impact the score on the System Usability Scale.

A high proportion of our participants also had experiences of working in health care. We can only hypothesize as to why this is the case; perhaps health care professionals are more likely to use eHealth services themselves. In future studies, it would also be of interest to see if health care professionals’ assessments of the usability of the PAEHR differ from other users, and, if so, how these assessments differ.

Finally, in this study, we have not further analyzed differences in characteristics between users who scored low on the SUS scale and those who scored higher. If we can distinguish characteristics of the low scorers, the needs of these users could be targeted in future redesigns of the PAEHR.

Information Access Through a National Solution

Since the Swedish PAEHR Journalen is built on a national platform, its design and functionality are the same for all users throughout Sweden. However, the clinical content or information that is accessible to patients varies depending on the local regulations in each region. Here, we had an opportunity to explore whether this level of transparency in a region would have an impact on the usability experienced by the end user.

Uppsala (a high transparency area) scored 80.71 and Skåne (a low transparency area) scored 79.37 on the SUS scale, with more than 1-point difference between the 2 groups. This might possibly be due to a lower level of transparency causing frustration among the users in Skåne. However, we cannot answer this question based on these results; many other factors could influence these results.

Conclusions

We conclude that the participants of this survey rated usability of the Swedish national PAEHR Journalen high (scoring 80 on the SUS); however, further research into more specific usability areas is needed to ensure usefulness and ease of use in the future. A somewhat higher SUS score for the region of Uppsala as compared with Skåne could indicate a relationship between the perceived usability of a PAEHR and the level of transparency regarding patients’ health information, but these differences in usability could also be related to other regional differences in the implementations of the PAEHR.
Acknowledgments
This research was partly funded through the patient-centered assessment of patients’ online access to electronic health records (PACCESS) project (2016-00623) supported by FORTE—the Swedish Research Council for Health, Working Life and Welfare. PACCESS is hosted by the DOME consortium, which studies the Development of Online Medical Records and eHealth Services. We would like to thank Inera AB for providing the data on the use of the national e-services and managing the survey and data collection through Journalen.

Authors’ Contributions
Both authors were involved in the analysis and writing of the paper, while MH took the main responsibility. IS also participated in the design of the study.

Conflicts of Interest
None declared.

References


**Abbreviations**

- **EHR**: electronic health record
- **PAEHR**: patient accessible electronic health record
- **SUS**: System Usability Scale

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The Role of Computer Skills in Personal Health Record Adoption Among Patients With Heart Disease: Multidimensional Evaluation of Users Versus Nonusers

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Abstract

Background: In the era of precision medicine, it is critical for health communication efforts to prioritize personal health record (PHR) adoption.

Objective: The objective of this study was to describe the characteristics of patients with heart disease that choose to adopt a PHR.

Methods: A total of 79 patients with chronic cardiovascular disease participated in this study: 48 PHR users and 31 nonusers. They completed 5 surveys related to their choice to use or not use the PHR: demographics, patient activation, medication adherence, health literacy, and computer self-efficacy (CSE).

Results: There was a significant difference between users and nonusers in the sociodemographic measure education ($P=.04$). There was no significant difference between users and nonusers in other sociodemographic measures: age ($P=.20$), sex ($P=.35$), ethnicity ($P=.43$), race ($P=.42$), and employment ($P=.63$). There was a significant difference between PHR users and PHR nonusers in CSE ($P=.006$).

Conclusions: In this study, we demonstrate that sociodemographic characteristics were not an important factor in patients’ use of their PHR, except for education. This study had a small sample size and may not have been large enough to detect differences between groups. Our results did demonstrate that there is a difference between PHR users and nonusers related to their CSE. This work suggests that incorporating CSE into the design of PHRs is critical. The design of patient-facing tools must take into account patients’ preferences and abilities when developing effective user-friendly health information technologies.

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KEYWORDS
patient portal; communication; patients; precision medicine; health literacy

Introduction

Precision Medicine in Cardiovascular Disease

The Precision Medicine Initiative is a nationwide initiative that was launched in 2015 to transform the United States health care delivery from a “one-size-fits-all” approach to one that takes into account individual variability in genes, environment, and lifestyle when providing patients with treatment and prevention strategies [1]. The primary goal of precision medicine is to provide optimized medical care and outcomes for each patient.
Benefits of precision medicine include increased prediction capabilities to determine which treatments work best for particular patients; better insight into the underlying mechanisms by which multiple diseases occur; enhanced methods for preventing, diagnosing, and treating a variety of illnesses; and improved electronic health records (EHRs) integration in clinical care, which promotes easier access to health data [2].

Management of life-threatening illnesses and chronic diseases has been progressing toward precision medicine for many years [3]. There has been exceptional precision medicine advancement related to cardiovascular disease (CVD) [4-8], which aids in the transformation of the management practice for CVD. Despite these advancements, CVD still ranks as one of the leading causes of death in the United States [9]. CVD contributes US $320 billion to health care costs annually. This includes the cost of health care services, medicines, and lost productivity due to death. This cost is projected to increase to US $818 billion by 2030 [10]. In addition to focusing on preventive measures to reduce the incidence of CVD, improving patients’ management of this disease will reduce the CVD’s economic cost on the health care system. Although targeted therapies related to cardiovascular medicine are less developed than in other specialties, such as oncology, these therapies have been acknowledged as a practical next step in patient-centered CVD treatments [4]. Patient-centered care relies heavily on patients becoming more involved in their health and wellness in order to achieve the optimal benefits from the health care system. Effective communication between health care providers and patients is necessary for health promotion efforts to be successful. New strategies, such as the personal health record (PHR), have been implemented to enhance the effectiveness of health information communication between patients and their providers.

**Patient Portal Use**

The Medicare and Medicaid EHR Incentive Programs advocate for patients to be involved in their health care. The PHR allows patients to electronically view their health information, after-visit summaries, credible educational materials, and reconcile their medication list [11]. PHR use should improve patient–provider communication, self-management of chronic illnesses, and medication adherence [12,13]. However, a data brief from the Office of the National Coordinator for Health Information Technology reported that although more than 90% of health care organizations offer patient portal access, less than 25% of patients actually use it [14]. Another study by Powell and Deroche [15] found that 35% of patients with a chronic disease have never used their patient portal. Patients with a chronic illness play an important role in their health improvement because chronic illnesses require continuous self-management efforts [16-19]. A study by Henry et al [20] found that providing educational information in patient portals can improve chronic disease self-management. Patients managing a chronic illness must be involved in and knowledgeable about their health. Patients who are engaged in their care are more inclined to follow treatment plans and manage their health [14,21,22].

Precision medicine offers promising improvements to health care. However, for this potential to materialize, it is necessary to involve patients in the process. In addition to generating targeted therapies, precision medicine will also generate complex risk and benefit information that will be hard to interpret for low-literacy populations [23]. Adoption of precision medicine in CVD will require patients to interact with complex results in their PHR. A literature review by Wynn et al [24] found that a patient’s health literacy impacts his/her ability to understand precision medicine materials; therefore, providing patient-facing materials that are understandable to all health literacy levels must be a priority when designing health information technology (HIT) tools.

Educational gaps in precision medicine exist for patients, which requires interventions to be implemented to improve knowledge, awareness, and attitude on how precision medicine will be incorporated into the patient experience and the PHR [25]. For patients to receive the most value from their PHR, the information presented within must be written at a level comprehensible to a lay audience so that they have the ability to act on the information received [26-30]. Research is needed to determine appropriate data display, visual aids, and understandable language that will foster adoption of the PHR; however, evidence remains limited in this area [24,31]. Previous research has focused on patient portal use among patients with multiple chronic illnesses, but none have focused solely on patients with CVD.

**Objective**

The promotion of technology-assisted disease self-management is increasing as PHRs continue to be adopted by health care organizations. Therefore, the objective of this study is to describe the characteristics of patients with heart disease who choose to adopt PHRs. Sociodemographic and propensity characteristics were explored among PHR users and non-PHR users.

**Methods**

**Study Design**

This study involved multiple, previously validated surveys completed by cardiovascular medicine patients affiliated with the University of Nebraska Medical Center (UNMC). This survey was administered between August 2015 and June 2019. UNMC’s Institutional Review Board approved this study as an expedited research project.

**Organizational Setting**

UNMC is an academic medical center whose clinical partner is Nebraska Medicine. The Division of Cardiovascular Medicine operates 3 clinics with over 28,000 annual patient visits. The team includes experts in general cardiology and a team of leading subspecialists in areas such as cardiac electrophysiology, interventional cardiology, structural heart disease, diagnostic cardiovascular imaging, congenital heart disease, advanced heart failure, mechanical circulatory support, and heart transplants. A nonprofit organization, Healthcare Information and Management Systems Society, rated UNMC with Stage 7 of the Electronic Medical Record (EMR) Adoption Model in
2016 [32]. A Stage 7 rating is awarded to hospitals and clinics with a fully integrated EHR that transports data using Continuity of Care Documents, utilizes data warehousing to assess clinical data, and demonstrates summary data continuity for all hospital services [33]. The PHR offered at UNMC is Epic (Verona) MyChart, a tethered PHR, and was available to patients at the beginning of 2014.

**Recruitment**

For our study, we recruited patients who received care at the UNMC’s Heart and Vascular Center. When eligible patients were identified, a nurse coordinator contacted patients via a telephone call. The recruitment phone call introduced the voluntary nature of the study, and explained what the patient’s participation in study would entail. Data collection sessions were scheduled and conducted in a clinic or adjacent conference room. Whenever feasible, the data collection session was linked to patients’ scheduled appointment for convenience. This method of connecting the data collection session with patients’ upcoming clinic visit was especially appealing to busier young and middle-aged adults. Participants were not compensated for their participation.

**Participants**

Overall, recruitment response was positive. A total of 95 patients were screened for participation in this research project. Of those, 16 declined while 79 accepted and participated in the research. Eligible participants were current patients of UNMC, scheduled for a clinic visit follow-up, 19 years old and older, and able to give consent. Use of the PHR was not a screening criterion. PHR users were defined as research patients who signed up for Nebraska Medicine’s Epic MyChart and sending at least one message prior to enrollment in this research project. Of the 79 who participated in the research there were 48 users and 31 non-users of the PHR.

**Data Collection**

Each data collection session lasted 15-30 minutes. After consent was obtained, the survey was administered. Sociodemographic data were collected followed by administration of 5 survey tools: the Computer Self-Efficacy (CSE) Survey, the Health Literacy Survey, the Medication Adherence Survey (MAS), and the Patient Activation Measure (PAM). These battery of surveys measure the patient’s comfort using computers, their general medical knowledge, their likelihood of taking prescribed medications, and their engagement in their care.

**Measures**

**Computer Self-Efficacy**

The CSE questionnaire is a 10-item survey that utilizes an 11-point Likert scale, and asks the patients’ confidence in completing a task under a variety of scenarios, such as when given step-by-step instructions, utilizing on-call user help, or initial training in getting started. Scores for each question range between 0 and 10, with the total score then between 0 and 100. The CSE has long been used to assess users’ belief that they can successfully interact with a computer system. Based on social psychology, self-efficacy has been found to influence the users’ behavior related to their use of the system [34].

**Health Literacy Survey**

The Health Literacy Survey is a 3-item survey that measures patients’ adequacy in understanding health information. Developed and validated by Chew et al [35,36], the Health Literacy Scale works well in a busy clinical environment. Health literacy and PAMs are both correlated with health outcomes, however Smith et al [37] noted a poor correlation between the 2 measures and argued that both should be targeted to improve patient safety and engagement.

**Medication Adherence Survey**

MAS is an 8-item patient survey that provides reliable predictions of patient medication compliance [38]. MAS has a strong correlation with clinical outcomes in patients with hypertension and other conditions [39]. Patients with greater knowledge, attitude, satisfaction, and coping skills were more likely to have high medication adherence, whereas those stressed or requiring a complex medication scheme were less likely to be adherent [40].

**Patient Activation Measure**

The PAM (Insignia Health) is a 13-item survey using a 4-point Likert scale. It is a robust and well-validated assessment tool developed by Hibbard and colleagues [41] to measure the level of patients’ engagement in their health. The PAM scale reflects a developmental model of activation. Activation appears to involve 4 stages: (1) believing the patient role is important, (2) having the confidence and knowledge necessary to take action, (3) actually taking action to maintain and improve one’s health, and (4) staying the course even under stress.

**Data Analysis**

Survey data were recorded and stored in a secure database and analyzed using SAS 9.4 (SAS Institute) in conjunction with a biostatistician (EL). The data were summarized using descriptive statistics which included counts and percentages, means, SDs, medians, and interquartile ranges. Patient characteristics were compared between PHR users and non-users using the Fisher exact test for categorical data and the 2-sample unpaired t test for continuous data. The 2-sample t test was used to compare the composite scores for the survey instruments between the groups. Missing data were handled using pairwise deletion (available-case analysis). In other words, results were reported for the nonmissing values for each variable analyzed. All tests were 2-sided and a P value of <.05 was considered statistically significant.

**Results**

Table 1 shows the demographics of patients with CVD that participated in this study. Responses are classified according to PHR users (48 participants) and PHR nonusers (31 participants). There was a significant difference between users and nonusers in the sociodemographic measure education (P=.04). There was no significant difference between users and nonusers in the sociodemographic measures age (P=.17), sex
(P=.35), ethnicity (P=.43), race (P=.42), and employment (P=.75).

There was a significant difference (P=.006) between PHR users and PHR nonusers in CSE (Table 2).

Figure 1 shows the mean CSE scores by survey items for PHR users and nonusers. Both users and nonusers reported being less able to complete a task using a computer software application if they had never used a computer application like it before.

### Table 1. Distribution of population characteristics categorized by PHR users and PHR nonusers (N=79).

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Nonuser (n=31)</th>
<th>User (n=48)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years), mean</td>
<td>63</td>
<td>57</td>
<td>.20</td>
</tr>
<tr>
<td>Sex, n (%)</td>
<td></td>
<td></td>
<td>.36</td>
</tr>
<tr>
<td>Male</td>
<td>18 (58)</td>
<td>22 (46)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>13 (42)</td>
<td>26 (54)</td>
<td></td>
</tr>
<tr>
<td>Education, n (%)</td>
<td></td>
<td></td>
<td>.04</td>
</tr>
<tr>
<td>Some high school</td>
<td>3 (10)</td>
<td>1 (2)</td>
<td></td>
</tr>
<tr>
<td>High-school graduate/general educational diploma</td>
<td>9 (29)</td>
<td>9 (19)</td>
<td></td>
</tr>
<tr>
<td>Some college/associate degree</td>
<td>10 (32)</td>
<td>17 (35)</td>
<td></td>
</tr>
<tr>
<td>College graduate</td>
<td>8 (26)</td>
<td>9 (19)</td>
<td></td>
</tr>
<tr>
<td>Postsecondary education</td>
<td>1 (3)</td>
<td>12 (25)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity, n (%)</td>
<td></td>
<td></td>
<td>.43</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>4 (13)</td>
<td>7 (15)</td>
<td></td>
</tr>
<tr>
<td>Not Hispanic or Latino</td>
<td>27 (87)</td>
<td>41 (85)</td>
<td></td>
</tr>
<tr>
<td>Race, n (%)</td>
<td></td>
<td></td>
<td>.42</td>
</tr>
<tr>
<td>American Indian/Alaskan Native</td>
<td>1 (3)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Black/African American</td>
<td>6 (19)</td>
<td>6 (13)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>24 (77)</td>
<td>42 (88)</td>
<td></td>
</tr>
<tr>
<td>Employment, n (%)</td>
<td></td>
<td></td>
<td>.63</td>
</tr>
<tr>
<td>Employed</td>
<td>11 (35)</td>
<td>19 (40)</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>20 (65)</td>
<td>29 (60)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Characteristics of PHR users and PHR nonusers.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Nonuser</th>
<th>User</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean (SD)</td>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Computer Self-Efficacy</td>
<td>30</td>
<td>46.23 (34)</td>
<td>45.5 (65)</td>
</tr>
<tr>
<td>Health Literacy</td>
<td>31</td>
<td>8.42 (29)</td>
<td>8 (2)</td>
</tr>
<tr>
<td>Medication Adherence</td>
<td>15</td>
<td>6.87 (1.25)</td>
<td>7 (2.25)</td>
</tr>
<tr>
<td>Patient Activation</td>
<td>31</td>
<td>64.34 (17.8)</td>
<td>55.62 (21.6)</td>
</tr>
<tr>
<td>Patient Activation Level</td>
<td>31</td>
<td>2.61 (1.05)</td>
<td>3 (2)</td>
</tr>
</tbody>
</table>
Discussion

Principal Findings

Overview

Our results show a significant difference between PHR users and PHR nonusers’ education ($P=.04$) and CSE ($P=.006$). This focus on patients with CVD. However, these results cannot be generalized to patients with an acute illness because of the different care required from chronic diseases. Although chronic disease is a major health care issue in the United States, the health care system is slow to re-adjust from an acute care focus to a system that addresses the complexities of chronic disease [42]. The use of HIT, such as PHRs, can support the management of chronic diseases. There is a lack of studies that look at PHR adoption among patients with heart disease. Patients with heart disease are an important group to study because CVD is a complex chronic disease and is one of the leading causes of death in the United States. Heart disease and stroke account for almost 801,000 deaths annually, costing US $316 billion in health care expenditures and lost productivity annually [43].

CSE plays a role in PHR acceptance and use. Previous literature on PHR adoption shows a difference between race and ethnicity in PHR use. Multiple studies found that Black and Hispanic patients were less likely to use a PHR as well as individuals with Medicare or Medicaid insurance [44-49]. Most of those studies recruited based on specific demographics as dependent not independent variables. Our results suggest that awareness of these disparities may have bolstered strategies focused on the demographics with lower usage rates in an effort to increase adoption [50]. A deeper analysis is needed to validate these results.

CSE’s Role in PHR Use

Our results demonstrate a difference between PHR users and nonusers in CSE, but not in other measured scales. CSE is significantly influenced by one’s computer knowledge and previous computer experience [51]. Having prior computer knowledge before using a PHR would increase CSE scores and likelihood of PHR use. Patients are more open to trying a PHR because they are familiar with how computer applications work.

Patient Activation Was Not a Factor in PHR Adoption

Another interesting finding is that patient activation was not a factor in PHR adoption. Previous studies have shown an association between PHR use and improved levels of patient activation [52-54]. Patients who are engaged in their care are less likely to adopt the PHR if they also have low self-efficacy. Our results implicate that patient’s comfort using technology plays a more important role in PHR use than patient activation.

Recommendations

It is important to address the challenges in using HIT for patients with lower literacy levels [55]. It is critical that the PHR’s display be tailored to the comprehension abilities of individuals with low computer literacy. Further, technological support should be made available when possible. Future research should examine the feasibility of computerized adaptive tests as screening tools to identify patients’ literacy skills [56,57]. Future research should also compare characteristics of patients receiving acute care versus chronic care in terms of their PHR.
adoption and use. Understanding these differences will assist in developing targeted interventions to improve PHR use.

Limitations
This study was limited to patients with cardiology issues; therefore, this study needs to be reproduced in other practice settings because of the specific information needs of the different specialties [58,59]. Recruitment came from a single academic medical center and the results need to be validated in multiple academic centers. This study had a small sample size and may not have been large enough to detect differences between groups. There may be specific patient characteristics that were not measured in this cohort that may have an effect on patients’ PHR usage.

Conclusions
CSE played a role in whether or not a patient would be a PHR user. Design of patient-facing tools must take into account patients’ preferences and abilities when developing effective user-friendly HIT tools [60]. Providing tools designed for the “average patient” will result in isolation of patients that do not fit into the “average” mold. Future research should explore the PHR features most used by patients with cardiology issues to understand how to prioritize functionality. Future HIT tools should be developed to overcome gaps in CSE. PHRs have the promise of improving chronic disease management and increasing patient engagement. Optimizing the PHR to support its intended users will provide the momentum needed to increase patient engagement in their care [61-63].

Acknowledgments
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Conflicts of Interest
None declared.

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Abbreviations

- CSE: computer self-efficacy
- CVD: cardiovascular disease
- EHR: electronic health record
- EMR: Electronic Medical Record
- HIT: health information technologies
- MAS: Medication Adherence Survey
- PAM: Patient Activation Measure
- PHR: personal health record
- UNMC: University of Nebraska Medical Center

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Independent Use of a Home-Based Telemonitoring App by Older Patients With Multimorbiditidy and Mild Cognitive Impairment: Qualitative Study

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Abstract

Background: The management of multimorbidity is complex and patients have a high burden of disease. When symptoms of dementia also appear, it becomes even more difficult for patients to cope with their everyday lives and manage their diseases. Home-based telemonitoring may support older patients with multimorbidity and mild cognitive impairment (MCI) in their regular monitoring and self-management. However, to date, there has been no investigation into whether patients with MCI are able to operate a telemonitoring app independently to manage their own diseases. This question has become even more important during the current COVID-19 pandemic to maintain high-quality medical care for this patient group.

Objective: We examined the following research questions: (1) How do patients with MCI assess the usability of the telemonitoring app? (2) How do patients with MCI assess the range of functions offered by the telemonitoring app? (3) Was there an additional benefit for the patients with MCI in using the telemonitoring app? (4) Were patients with MCI able to use the telemonitoring app independently and without restrictions? (5) To what extent does previous experience with smartphones, tablets, or computers influence the perceived ease of use of the telemonitoring app?

Methods: We performed a formative evaluation of a telemonitoring app. Therefore, we carried out a qualitative study and conducted guided interviews. All interviews were audio-recorded, transcribed verbatim, and analyzed using the Mayring method of structured content analysis.

Results: Twelve patients (8 women, 4 men) were interviewed; they had an average age of 78.7 years (SD 5.6) and an average Mini-Mental State Examination score of 24.5 (SD 1.6). The interviews lasted between 17 and 75 minutes (mean 41.8 minutes, SD 19.4). Nine patients reported that the telemonitoring app was easy to use. All respondents assessed the range of functions as good or adequate. Desired functionalities mainly included more innovative and varied educational material, better fit of the telemonitoring app for specific needs of patients with MCI, and a more individually tailored content. Ten of the 12 patients stated that the telemonitoring app had an additional benefit for them. Most frequently reported benefits included increased feeling of security, appreciation of regular monitoring of vital parameters, and increased independence due to telemonitoring. Eight patients were able to operate the app independently. Participants found the app easy to use regardless of whether they had prior experience with smartphones, tablets, or computers.

Conclusions: The majority of examined patients with MCI were capable of operating the telemonitoring app independently. Crucial components in attaining independent use were comprehensive personal support from the start of use and appropriate
design features. This study provides initial evidence that patients with MCI could increasingly be considered as a relevant user group of telemonitoring apps.

**Introduction**

**Background**

Multimorbidity, defined as the simultaneous occurrence of at least two chronic diseases, is a characteristic of the health situation of older people and is common among those in high-income countries [1]. In 2019, more than 58% of adults aged 65 years or over were suffering from multimorbidity in Organisation for Economic Cooperation and Development (OECD) countries and this figure reached up to 70% or more in Germany [2]. The management of multimorbidity is often complex, and patients face several challenges in terms of understanding and self-managing the conditions and medication, regularly monitoring several clinically relevant vital parameters, and coordinating multiple medical services [3,4]. Multimorbidity is also associated with polypharmacy, including the risk of adverse drug events, a decline in physical functioning, or increased health care utilization such as emergency admissions [5-9]. This often results in decreased quality of life, including psychological distress [1,5,9]. Moreover, mental illnesses such as anxiety and depression are more common in patients with multimorbidity [3]. When symptoms of dementia also appear, it becomes even more difficult for patients to cope with their usual and independent tasks in daily life and manage their own diseases [3]. Additionally, symptoms of dementia act as risk multipliers across all age and morbidity strata, leading to worse health outcomes [10]. It is estimated that in 2019, nearly 20 million people had dementia in OECD countries. This number will more than double by 2050 if current developments continue [2]. Mild cognitive impairment (MCI) represents a preclinical, transitional stage between healthy aging and dementia. MCI has been shown to affect 10%-15% of the population 65 years and older. Each year, 10%-15% of people with amnestic MCI progress to Alzheimer disease compared to only 1%-2% of the healthy older population [11].

Telemonitoring can play an important role in coping, compensating, and supporting cognition [12,13]. Regular home-based telemonitoring may support older patients with multimorbidity and MCI in their self-management and regular home monitoring of clinically relevant vital parameters. Furthermore, telemonitoring may help patients to feel more secure, remain longer and independently in their familiar home environment, and increase overall quality of life. At the same time, telemonitoring helps to relieve the burden on formal and informal caregivers [12-16].

There are already a large number of telemonitoring apps available for different kinds of chronic diseases, with corresponding usability and acceptance evaluations that have been summarized in several systematic reviews [17-20]. However, the number of existing studies and evaluations on telemonitoring apps focusing on multimorbidity is currently limited [21-23]. Another issue that has not yet been investigated is whether patients with MCI are able to use a telemonitoring app independently, and how they assess usability and acceptance. This target group is considerably large and so too is the associated potential for improved care. Therefore, the aim of this study was to help close this research gap.

Within our study, “usability” was defined as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use” [24], whereas user acceptance was defined as the “attitude towards a particular situation” [25].

The question of whether patients concurrently suffering from multiple chronic diseases and MCI would be able to use telemonitoring apps has become even more important in recent months due to the COVID-19 pandemic. Telemonitoring apps can be of great value, especially for vulnerable patient groups such as the chronically ill, as patient care was only possible to a limited extent during the lockdown. For example, outpatient visits were cancelled or postponed, and the availability of in-person support services was reduced [26,27]. In addition, especially in such isolation situations, people with chronic illness depend on close health care to prevent serious complications or even death resulting from those complications [28-30]. The health care system needs to respond to the needs of patients suffering from chronic noncommunicable diseases, which are the majority of conditions [31]. Disease-tailored and easy-to-use home-based telemonitoring solutions could be a suitable measure to continue the care for chronically ill patients while maintaining the legally required social distance, and to give them the secure feeling of being well cared for [28,29,32].

**Study Aims and Research Questions**

This study was part of the feasibility study “Autonomy despite multimorbidity in Saxony through patient empowerment, holistic care for older people with networking of all regional institutions and service providers” (ATMoSPHAERE) performed between October 2015 and June 2019. The main aim of the study was the iterative development of a technology-based information and communication platform enabling an intersectoral networking of treating physicians in practices, nurses, therapists, social services, and patients with multimorbidity and their caregivers. The comprehensive study design has already been reported elsewhere [33,34]. Within the study, a telemonitoring app for patients was developed (see Description of the Telemonitoring App in the Methods section). The aim of this study was to perform a formative evaluation of the
telemonitoring app from the perspective of older patients with multimorbidity suffering from MCI.

In detail, we examined the following research questions by means of a qualitative study: (1) How do patients with MCI assess the usability of the telemonitoring app? (2) How do patients with MCI assess the range of functions offered by the telemonitoring app? (3) Was there an additional benefit for the patients with MCI in using the telemonitoring app? (4) Were patients with MCI able to use the telemonitoring app independently and without restrictions? (5) To what extent does previous experience with smartphones, tablets, or computers influence the perceived ease of use of the telemonitoring app?

Overall, our formative evaluation had two aims. The first aim was to examine the usability of the app and possibilities of independent use to evaluate its perceived ease of use. The second aim was to evaluate the content and the additional benefits resulting from the use of the telemonitoring app to assess its perceived additional benefits. Both evaluation issues were equally relevant for an adequate evaluation to develop an individually tailored telemonitoring app.

Methods

Study Design

We opted for a formative evaluation to assess a telemonitoring app that was under development while performing this study. Patient feedback from the interviews provided important aspects for the further iterative development process of the telemonitoring app in line with the needs of the target group [35-37].

When planning the substudy, we had to consider what could be expected of this target group. We had to make sure that the formative evaluation would not lead to excessive demands over and above those caused by actual usage of the telemonitoring app. Keeping this in mind, we decided to apply only one iteration stage and chose the qualitative method of guided interviews for this target group.

We opted to use personal interviews instead of questionnaires since we expected a certain degree of insecurity and restraint toward the research topic among the participants due to a possible lack of previous experience [38]. We used this method as it was particularly advantageous for our vulnerable patient group. This method enabled a personal conversation, thus facilitating a relationship of trust to be established; if necessary, one could explain something again or, in case of ambiguities, one could specifically ask for more information. Additionally, this approach enabled us to adapt the interview guideline flexibly according to the participants and their individual characteristics (e.g., health status, individual burden of disease, life situation), and their previous experience in handling tablets, smartphones, or telemedicine solutions [39-41]. At the same time, the use of an interview guideline enables comparisons between the interviews and also prevents storytelling from digressing too far [40,42,43].

Recruitment of General Practitioners and Study Patients

Potential general practitioners were partners within a network of accredited academic teaching practices. Their practices were located in the city of Dresden, Germany, with approximately 560,000 inhabitants. Interested general practitioners were recruited in network meetings. They were informed about the study and signed a declaration of consent form.

Study patients were recruited by the general practitioners. Study nurses screened patients by applying the validated measuring instruments Mini-Mental State Examination (MMSE; assessment based on [44], German version [45]) and the Clock-Drawing Test [46] to assess cognition, as well as the Timed Up & Go test [47] to assess the mobility of potential study patients. The crucial factor for study inclusion was the degree of cognitive impairment, which was assessed by an MMSE score of 20-26 at the baseline assessment. Patients who were found to be eligible and met the inclusion criteria (Textbox 1) were informed by their general practitioner about the study and received written information. After patients decided to participate, they signed a declaration of consent form. Patients could withdraw their consent at any time.

Study patients were asked about their readiness for a personal interview after using the telemonitoring app for at least 2 months. After the study patients agreed to be interviewed, a researcher informed them about the interview details. Participants were included regardless of whether or not they had prior experience with the use of smartphones, tablets, or computers.
**Textbox 1. Study inclusion and exclusion criteria.**

**Inclusion criteria**
- Age ≥ 65 years
- Multimorbidity (presence of at least two chronic diseases)
- Mild cognitive impairment defined by a Mini-Mental State Examination (MMSE) score between 20 and 26 or mild dementia according to International Classification of Diseases (ICD)-10
- Capable of understanding patient information and consenting to the study
- Independent operation of television via remote control and/or computer/laptop three or more times per week
- Unimpaired hearing
- Sufficient motoric and sensory speech ability
- Sufficient eyesight to follow a television program easily

**Exclusion criteria**
- Missing capacity of consent
- Unable to speak German fluently
- Moderate to severe dementia defined by an MMSE score <20 or according to ICD-10
- Motoric impairment (Timed-Up & Go test ≥ 30 seconds in initial measurement, 20-29 seconds in two repeated measurements)
- Severe psychiatric comorbidities (eg, schizophrenic psychoses, addictions)
- Currently participating in a comparable telemonitoring program or participation within the last 12 months

**Description of the Telemonitoring App**
The telemonitoring app was provided by the technical project partner Philips Medical Systems GmbH (hereafter Philips) and consisted of the telemonitoring software Motiva, the telemonitoring hardware in the form of a tablet (ASUS ZenPad 7.0 or Samsung Tab 4), as well as a Bluetooth-enabled sphygmomanometer. Figure 1 shows images of the telemonitoring app’s user interface.

After study inclusion, study patients were instructed at home on the use of the hardware and software by a technician from the German Red Cross. In addition, they received a user manual where essential functions were explained in an easy-to-understand way.

Table 1 provides an overview of the functionalities offered by the telemonitoring app and the corresponding tasks that patients were responsible for performing according to the general practitioner’s treatment regime.

All collected patient data were transferred to the ATMoSPHAERE platform and could be viewed by the responsible general practitioner (Figure 2).

**Figure 1.** Screenshots of the user interface of the telemonitoring app.
Table 1. Overview of functionalities of the telemonitoring app and patient tasks to be performed.

<table>
<thead>
<tr>
<th>Functionalities offered by the telemonitoring app</th>
<th>Patient tasks to be performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement of vital data with provided measuring devices at predefined times according to the general practitioner’s treatment regime; data are automatically transmitted to the tablet and to a German Red Cross care coordination center for intervention necessity assessment</td>
<td>Once per week: measurement of blood pressure and heart frequency</td>
</tr>
<tr>
<td>Continuous weekday monitoring of measured vital data values by case and care managers at the care coordination center; these managers contact patients in case of exceeding vital data values for possible therapeutic intervention (thresholds predefined by general practitioner)</td>
<td>Completing intervention questionnaires providing information about the reasons for deviation to the case and care managers to derive possible therapeutic interventions</td>
</tr>
<tr>
<td>Overview of measured vital data and vital data charts</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Regular provision of patient questionnaires</td>
<td>Once at the beginning: completing a questionnaire on general health conditions</td>
</tr>
<tr>
<td></td>
<td>Once per week: Completing questionnaires on treatment modifications, medication adherence, sleeping habits, pain, alcohol and tobacco consumption, and the disease-specific health status (eg, chronic heart failure and type 2 diabetes)</td>
</tr>
<tr>
<td></td>
<td>Depending on individual needs: completing additional questionnaires sent by the case and care managers (eg, on the topics of nutrition and depression)</td>
</tr>
<tr>
<td>Provision of educational and training material, particularly instructional videos for individual chronic diseases</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Receiving messages from the case and care managers (eg, reminder of measurement or answering questionnaires, video recommendations, or congratulations on milestones)</td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

Figure 2. ATMoSPHAERE network including the telemonitoring app. ATMoSPHAERE: Autonomy despite multimorbidity in Saxony through patient empowerment, holistic care for older people with networking of all regional institutions and service providers.

Theoretical Framework and Interview Guideline

As a basis for the guided interviews, we developed a uniform guideline with open-ended questions (see Multimedia Appendix 1). A specially created set of usability criteria and comprehensive overview of acceptance factors with explicit regard to the requirements of older people concerning telemedicine apps has previously been developed and published by one of the authors of this study [38,48,49], which has been used in several studies to evaluate telemonitoring apps for older people [50-53]. These criteria served as the theoretical framework for guideline development. Guideline development and formulation of interview questions also were established following guidelines from the relevant methods literature [39,54,55].

Data Collection

The patient interviews were conducted between June 2016 and December 2017. Continuous study inclusion facilitated the interviewing of new study participants throughout the study period. All study patients received the same telemonitoring equipment (tablet, sphygmomanometer). To enable comparisons among patients, all interviews were based on the same interview
guideline. All patients opted for a face-to-face interview at their homes. All interviews were audio-recorded.

**Data Evaluation**

All interviews were transcribed verbatim. The transcripts then served as the foundation upon which consecutive data analysis was performed. All interviews were analyzed applying the method of structured content analysis developed by Mayring [56]. This is the central content analysis technique and allows for an association between the deductive and inductive creation of categories [56,57]. The analytical focus was on designing a system of categories and subcategories, as well as their characteristics [56], which in turn served as structural dimensions.

Coding started with the development of an initial deductive category system derived from the questions in the interview guideline, discussed and agreed upon within the research team (DD, KA, MS, EL). Two analyzing researchers (EL, MS) coded two interviews independently to further develop the category system. These researchers differed in age and gender to allow for diversity of perspectives in the context of data analysis. This was then discussed by the entire research team and consolidated. The consolidated category system was then used by two researchers (EL, MS) as the basis for coding all interviews. During analysis, the coders independently specified, modified, or removed categories based on the text material. Missing but relevant categories were added inductively based on the transcripts. This process was continued until saturation of the category system was reached (ie, no new categories emerged) [57].

The inductive development of categories was carried out as follows. Based on the textual material in the transcripts, units of meaning formed the units of analysis. Relevant content of the units of meaning was paraphrased to generate a category label. In accordance with recommendations from the methodological literature, a low level of abstraction was initially selected for the generation of category labels [56]. It was scaled down in the course of analysis and further review of the text material. Subsequently, the abstraction level of the different categories was harmonized to reach a final uniform abstraction level of the category system. Finally, the assignment of individual text sections to the respective categories was reviewed again by the entire research team. Differences in coding were discussed and resolved by consent. If necessary, text segments were recoded accordingly.

Our approach complied with the principles of openness and investigator triangulation within qualitative research [40,54]. For data analysis, the software MAXQDA (MAXQDA Plus 12 portable) was used.

The chosen method allowed us to individually adapt the interview guideline to the actual interview and to the aspects presented as relevant by the participants. In turn, this resulted in interviews where we were not able to ask all possible questions, patients did not answer questions even after the question was repeated, or where the participants themselves added new aspects.

**Ethics Approval**

The ethics committee at Technische Universität Dresden (approval number EK 1012016) approved the study.

**Results**

**Patient Characteristics and Interview Duration**

Of the 19 participants that met the inclusion criteria of our study, 12 agreed to be interviewed. To achieve the greatest heterogeneity possible within our study sample, we interviewed all 12 patients. The interviews lasted between 17 and 75 minutes (mean 41.8 minutes, SD 19.4). Table 2 shows the patient characteristics of the selected cohort.

Ten study patients used an Asus ZenPad 7.0 tablet and two study patients used a Samsung Tab 4.
Table 2. Characteristics of the interviewed patients and the average result of the Mini-Mental State Examination (MMSE) (N=12).

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Sample value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender, n (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4 (33)</td>
</tr>
<tr>
<td>Female</td>
<td>8 (67)</td>
</tr>
<tr>
<td>Age category (years), n (%)</td>
<td></td>
</tr>
<tr>
<td>65-74</td>
<td>2 (17)</td>
</tr>
<tr>
<td>75-85</td>
<td>9 (75)</td>
</tr>
<tr>
<td>≥86</td>
<td>1 (8)</td>
</tr>
<tr>
<td>Age (years), mean (SD)</td>
<td>78.7 (5.6)</td>
</tr>
<tr>
<td>Marital status, n (%)</td>
<td></td>
</tr>
<tr>
<td>Single/widowed</td>
<td>6 (50)</td>
</tr>
<tr>
<td>Married/cohabitation</td>
<td>6 (50)</td>
</tr>
<tr>
<td>Number of comorbidities, n (%)</td>
<td></td>
</tr>
<tr>
<td>2-8</td>
<td>7 (58)</td>
</tr>
<tr>
<td>≥9</td>
<td>5 (42)</td>
</tr>
<tr>
<td>Comorbidity, n (%)</td>
<td></td>
</tr>
<tr>
<td>Essential (primary) hypertension</td>
<td>10 (83)</td>
</tr>
<tr>
<td>Type 2 diabetes mellitus</td>
<td>5 (42)</td>
</tr>
<tr>
<td>Chronic ischemic heart disease</td>
<td>4 (33)</td>
</tr>
<tr>
<td>MMSE score, mean (SD)</td>
<td>24.5 (1.6)</td>
</tr>
</tbody>
</table>

Assessment of Usability by Patients With MCI

***Usability of the Telemonitoring App***

With respect to experience during the initial phase of use, 7 of 10 patients reported that the telemonitoring app was difficult to understand at the beginning. Six of 11 patients reported a feeling of insecurity.

"Well, in the beginning I was also doubtful: Can you do it or not or are you doing something wrong? And I was just told, if you entered something wrong, you can always do it again." [Patient 47]

"Well, I first had to fumble a bit with the thing. I have just a normal phone here. [...] Now it’s fine." [Patient 214]

After talking about the initial phase, we asked patients to describe the current usage situation. We observed a clearly positive development. Nine of the 12 patients reported that the telemonitoring app was easy to use at this time: “I find it easy to use. At the beginning [...] I was also anxious.” [Patient 47]

After being asked about difficulties in using the telemonitoring app, one patient answered: “Well, actually nothing more. But the first time, I hadn’t really gotten into it. But that was a long time ago.” [Patient 214].

With respect to individual usability aspects of the telemonitoring app, 7 of 10 patients understood the presentation of the contents of the telemonitoring app well (ie, the used figures and language). Seven of nine patients rated the used symbols as easy to understand.

*The questions which are written in the blue box are clear. And then there’s “Start” or “Back” if I said something wrong.* [Patient 37]

*Yes, that’s all explained in the manual, yes. It’s a nice red triangle, you practically have to press on it and you just need to read it properly.* [Patient 47]

The size of images and illustrations (8/8), the font size (12/12), as well as the color contrast (10/10) were rated as perfectly appropriate by all patients who answered these questions within the interviews.

As another aspect of usability, the effort to make inputs was perceived to be less burdensome by almost all patients (10/11). Seven of 11 patients pointed out that this was made possible due to the automated transmission of vital data from the measuring device to the tablet. Six of seven patients rated the menu navigation as simply structured and easily comprehensible.

***Tablet Usability***

When examining the usability of a telemonitoring app, it is also worth considering the ease of use of the corresponding hardware in terms of the tablets.

Nine of 10 patients expressed that the tablet was easy to use. However, the patients reported functional problems with the hardware. The very slow startup of the tablet, including difficulties in finding an internet connection (7/9), and the arbitrary change of the device into flight mode, including...
difficulties in transferring the measured vital data to the ATMoSPHAERE platform (4/9), were most frequently mentioned. Three of nine patients reported difficulties in operating the On/Off switch and the same number were bothered by a low battery life or long charging time of the tablet. These functional issues had a negative impact on the overall satisfaction with the telemonitoring app provided, with only six of nine participants having reported being very satisfied or rather satisfied.

Interviewer: So, on the whole, would you say it’s fun to use that or rather not so much fun?

Patient 225: If it worked right, I would enjoy it [...].

Interviewer: Yes, but as it is now?

Patient 225: [...] I always approach it with a bit of mixed feelings.

**Range of Functions of the Telemonitoring App**

Six patients assessed the telemonitoring app’s range of functions and all rated it as good or adequate. They also named desired functionalities to be included in the app. Three items were most frequently mentioned. The first item involved provision of more innovative and varied educational materials:

Yes, but that’s always the same, isn’t it? [...] It is always the same there. The woman, I don’t know her name and blood sugar and stuff. That’s something that gets on my nerves [Patient 214]

The second item was related to a better fit of the telemonitoring app to the specific needs of patients with MCI:

The only thing I have, that really concerns me is my short-term memory. And that is not being treated here. [...] I wish it were, because many people feel that way. [...] And then also about the operating instructions, you could get something every 2 months or 3 months short, a small article, on one page, that’s enough: “We’ll tell you again about the operating instructions.” [Patient 245]

Support for dementia development is not in here, is it? But I still hope that maybe at some point it will be further developed, that maybe some suggestions will be implemented. [Patient 55]

The third item was related to having more individually tailored contents of the telemonitoring app in terms of more individualized questionnaires and response categories or by considering additional diseases within the range of functions:

A huge number of food suggestions and so on. But then, maybe other things that would be more interesting. They cannot be queried. I don’t know. You can’t write anything in it by yourself. [Patient 245]

**Additional Benefits, Negative Effects, and Changes in Everyday Life of Patients With MCI**

**Additional Benefits of the Telemonitoring App**

Ten of the 12 patients stated that the telemonitoring app has an individual additional benefit for them. Eight of the 12 patients stated that they have an increased feeling of security owing to the regular transmission of vital data, and the knowledge that case and care managers are checking their values and will contact them in case of exceeding critical values. Patients reported: “They’ll take care of me” [Patient 225] and “[...] one is monitored and that is not wrong in my opinion” [Patient 179]. The fact that some of the interviewees did not have supporting family members in the direct neighborhood reinforced that feeling.

Five of the 12 patients regularly measured their blood pressure only since having started using the telemonitoring app and appreciated that kind of monitoring: “Well, you either just do it or you forget and here, I do it” [Patient 214].

Four of the 12 patients rated as positive the possibility of being able to monitor blood pressure independently of the general practitioner’s visit according to their individual needs/feelings. According to one patient, this leads to “[...] independence because you know it’s your blood pressure, everything is fine. And you can just go. [...] in the beginning someone always had to go shopping with me” [Patient 47].

Furthermore, the following aspects were positively rated by the interviewed patients: the availability of more health-related data as an improved basis for general practitioners’ treatment decisions, an individualized overview of the development of vital parameters, and the perception of the telemonitoring app as a welcome change to everyday life.

**Negative Effects of Using the Telemonitoring App**

Aside from the additional benefit of telemonitoring app use, which was central for the majority of interviewed patients, 2 of the 12 patients also reported negative effects in using the telemonitoring app. The study-related, more frequent measurement of vital data led to uncertainty, because patients could not properly classify fluctuating values due to their lack of expertise. Patients were aware that case and care managers from the German Red Cross intervened in instances of exceeding values, but even slight fluctuations seemed to lead to uncertainty. In addition, differences in the values between the devices used in the study and patients’ own measurement devices were reported to be disturbing.

**Changes in Everyday Life From Using the Telemonitoring App**

We also asked the participants to what extent their everyday life has changed due to the use of the telemonitoring app. Six of nine patients reported that study participation and regular measurements did not represent any significant changes: “[...] you accept this early in the morning, this 5-minute thing in no way makes it difficult” [Patient 179]. Three of nine patients stated that the telemonitoring app even simplified their everyday life. They rated the effort to use it as very little and its integration into everyday life as simple.
Ability of Patients With MCI to Use the Telemonitoring App Independently

Almost all patients (10/11) had received further support after their initial introduction to the telemonitoring app at home. Most commonly (8/11), they received telephone support from the case and care managers at the German Red Cross or got help directly from Philips, or a German Red Cross technician visited patients at their home in the case of serious problems. Four of 11 patients stated that they had used the user manual, which had been given to them at the beginning of use. Besides the support by project staff, family members assisted patients in using the telemonitoring app. For 3 of 11 patients, the partner/spouse and for 4 of 11 patients, other family members such as children and grandchildren played an important role in handling the app. In some cases, patients were not using the telemonitoring app themselves: Patient 55 (supported by daughter), Patient 61 (supported by wife), as well as Patient 68 and Patient 99 (supported by husbands). Patient 68 and Patient 99 showed the lowest MMSE scores (22) within the study population; Patient 55 showed an MMSE score of 26 and Patient 61 had a score of 25. Patients 61 and 68 each had a supporting spouse; these spouses had been included in the overall study (but not in this substudy) and had each achieved a higher MMSE value themselves. This might be the main reason that these supporting spouses took care of the transmission of vital data and other aspects of study participation.

The other eight patients were able to operate the telemonitoring app independently, in spite of their MCI.

Influence of Previous Experience With Smartphones, Tablets, or PCs on Perceived Ease of Use of the Telemonitoring App

Three of the 12 patients reported previous experience with a computer but not with a smartphone or a tablet. One patient stated previous experience with a smartphone/tablet but not with a computer. Two patients had already used both a computer and a smartphone/tablet. Two patients had never used a computer, smartphone, or tablet before. Four patients did not comment on this question.

In the context of evaluation, we considered separately to what extent people without prior experience might have had greater difficulties in using the telemonitoring app. The participants found the app easy to use regardless of whether or not they had prior experience, and there were no clear differences in the assessment of the individual usability aspects examined. Only one of the 12 patients, who already had previous experience with a smartphone, found the telemonitoring app difficult to use.

Discussion

Main Findings

To our knowledge, our study is the first to investigate whether patients with multiple chronic diseases, and how they evaluate its usability and additional benefits for their everyday life.

As one main result, we were able to show that the majority of examined patients with MCI were capable of operating a telemonitoring app independently. However, we also found the following framework conditions and features of the telemonitoring app to be crucial preconditions for independent telemonitoring by patients with MCI, resulting in high perceived ease-of-use: personal support and design features.

All patients, with one exception, received further support after their initial introduction to the telemonitoring app at their home. Most commonly, they received telephone support from the case and care managers at the German Red Cross or directly from Philips, or a German Red Cross technician visited the patients at home in the case of major problems. Thus, a personal introduction and the availability of constant and familiar contact persons are important in decreasing the perceived effort of use and increasing acceptance among this target group. Our previous studies with older patients suffering from chronic diseases also found this to be a key acceptance factor [38,49]. These factors have already been assessed as crucial in the “Senior Technology Acceptance & Adoption Model (STAM)” [58] and by Schmid et al [59]. Furthermore, the availability of constant and familiar contact people also reduces the fear that using technology may result in loss of human contact [12].

Perceived ease of use and perceived additional benefit are the main impact factors on user acceptance within various well-known technology acceptance models [58,60,61]. The following design features of the telemonitoring app examined resulted in high usability, and therefore in high perceived ease of use, for patients with MCI: (1) use of understandable semantics (eg, no foreign language words or technical terms that are not generally understandable); (2) use of easily understandable outputs and displays; (3) easily understandable and self-explanatory menu structures; (4) easily understandable navigation to the desired content of the telemonitoring app; (5) sufficient sizes of fonts and illustrations; (6) sufficient color contrast; (7) low input effort through automatic transmission of blood pressure values; and (8) clearly understandable feedback from the platform on (incorrect) input.

The telemonitoring app examined largely met the criteria that earlier studies have shown to be crucial for a high level of usability for older users [12,38,48,49,59]. This in turn led to higher user adherence [62]. However, usability was partly restricted by functional problems of the hardware that resulted in patient dissatisfaction. These reliability problems can result in a lack of trust and less extensive use or even end of use [34,63,64]. Hardware robustness and a stable internet connection are two key requirements for enabling the use of a telemonitoring app. Both have been highlighted as crucial issues in many studies [53,65,66]. If both requirements are not met, independent operation and use of support services are significantly more difficult or even not possible. Vulnerable individuals, especially those with cognitive impairment, could become worried by experienced difficulties. This can lead to the fact that otherwise useful telemonitoring apps may not be beneficial for these patients. Additionally, a fundamentally high usability of the telemonitoring app and permanently available contact persons for technical questions are crucial to relieve the burden on informal caregivers. For older patients with MCI,
these people are often the first point of contact for questions and usage problems, and difficulties would thus put them under additional strain [67,68].

As another main result, our study revealed that the participants found the telemonitoring app easy to use regardless of whether or not they had previous experience with the use of smartphones, tablets, or computers; this presupposes that the telemonitoring app has the relevant design features mentioned above and that personal support is continuously available on weekdays.

However, our study results also discovered that some of the patients hardly ever worked with the app themselves, and their relatives predominantly operated the app instead. In future studies, patients experiencing difficulty could possibly operate the telemonitoring app together with their spouses or other relatives living close by. This could contribute to a feeling of security and support for both sides. However, the use of the telemonitoring app can be problematic for patients who live alone and do not receive any support from other individuals. Therefore, future research should examine how a telemonitoring app with personal support should be designed and function to enable independent usage by this vulnerable target group. In this context, future telemonitoring apps should be developed in close cooperation with patients with MCI to consider their needs and perspectives comprehensively. This kind of codesigning has also been emphasized as a central requirement for a high degree of usability and user acceptance within several studies [14,69-72]. In addition, greater patient involvement can lead to empowering effects among this patient group [70,71].

The majority of patients with MCI perceived the telemonitoring of their state of health as beneficial. Most frequently, the patients reported an increased feeling of security. Other studies have also shown this aspect as a significant benefit of telemonitoring app usage by older patients [73,74]. In addition, the possibility of being able to measure blood pressure independently of a general practitioner visit led to more autonomy and independence according to the opinion of four study patients. Several studies have shown autonomy of patients to be a positive outcome of telemedicine interventions, as indicated in a recent review by Kruse et al [75]. This effect is especially valuable for multimorbid, older patients with MCI who are facing several challenges in terms of understanding and self-managing their health conditions [8,9]. The management of multimorbidity is often complex, and patients face several challenges in terms of understanding and self-managing the conditions and medication, regular monitoring of several clinically relevant vital parameters, and coordinating multiple medical services [3,4].

Our study also showed that patients with MCI desired greater consideration of individual characteristics within the telemonitoring app. They explicitly asked for more individualized questionnaires and response categories. They also stated that additional diseases should be considered in the development of the telemonitoring app. Other studies also verified an individually adjustable and modular content of the app to be crucial for increasing perceived usefulness among the highly heterogeneous older population with chronic illnesses [38,48,49,59,69,73,76]. The challenge for the app development process is to enable customization and guarantee high usability at the same time. The consideration of artificial intelligence or self-learning approaches could be useful in this matter.

This study was a formative evaluation as part of an iterative development process. The telemonitoring was further developed in accordance with the feedback from the interviews. In the course of the project, patients were also able to use Fresh Minder apps for memory training [77]. Moreover, additional questionnaires and care plans (eg, for pain, dizziness, sleep, and activity) were developed and implemented, and offers for potentially helpful social and nursing services were added.

With regard to coping with the effects of the COVID-19 pandemic, our results have shown that telemonitoring of older patients with multimorbidity and MCI is feasible. Studies have also shown that the pandemic has changed health care toward increased acceptance and utilization of telemedicine by both patients and providers [29,32]. Furthermore, telemonitoring can help to reduce fears, insecurities, and the feeling of social isolation among those affected [29], which also plays an important role in coping with the COVID-19 pandemic.

**Implications for Future Research**

Telemedicine solutions for patients with MCI had already focused on the following topics, which have been systematically reviewed by Lorenz et al [13]: preservation or improvement of memory performance [78,79], app-based memory training [77,80], preservation of fitness and agility [81], preservation of an independent way of life [82], and provision of information about dementia [79]. All of these topics focused exclusively on patients with cognitive impairment. Future research should focus more on influencing factors enabling patients with multimorbidity and MCI to take an active and participatory role within their treatment process by using telemonitoring apps. Furthermore, research is needed to examine up to which severity stage of dementia patients are able to use a telemonitoring app. Therefore, more qualitative and quantitative studies are required to explore this topic in further detail.

Future studies should be performed in a controlled design. It would be expedient to investigate whether and how telemonitoring itself, and the increased feeling of security and independence, affect the number of general practitioner visits, vital parameters, disease progression, medication adherence, emergency admissions or admissions to nursing homes, quality of life, depression, or empowerment. Furthermore, a health economic evaluation would be useful to examine whether the use of such a telemonitoring app can lead to better care at the same costs or with cost savings.

**Implications for Practice**

Our study provides initial evidence for the usage of a telemonitoring app by individuals with MCI. We showed that patients with multimorbidity and MCI can be considered as a target group for the use of telemonitoring apps if the above-mentioned conditions are met. For general practitioners and other health professionals, it is important to carefully select which patients are suitable for using such technology and to intensively discuss this option with the patients. Any existing concerns can also be addressed in this context. The patient’s needs and own perceptions, including in the sense of...
self-selection, are essential requirements for successful use. For individuals with various preexisting chronic conditions, it is essential to carefully determine whether such an app offers effective support. Basically, such apps must fit into the individual treatment pathway and should not represent an additional burden for either the patient or the physician. In this context, it should be taken into account whether relatives are available or whether the patient lives alone and how this might affect use of the telemonitoring app. In addition, the general practitioner or health care professional and the patient should regularly assess and jointly decide whether or not such an app remains suitable.

Overall, the COVID-19 pandemic has caused a rethinking of many issues, which may lead to greater receptiveness among this patient group and treating physicians for such apps.

**Strengths and Limitations**

This study was carried out as part of the ATMoSPHAERE project, which ended in June 2019 and focused on older patients with MCI. To our knowledge, our study was the first to investigate whether patients with MCI are able to operate a telemonitoring app for managing symptoms of their multiple chronic diseases. We were able to show that the majority of examined patients with MCI were capable of operating a telemonitoring app independently. With regard to ensuring adequate care for multimorbid, chronically ill patients with MCI during the COVID-19 pandemic, this result is highly valuable. Furthermore, our results on relevant acceptance and usability factors of such a telemonitoring app provide important information for the design and implementation of future home-based telemedicine solutions. Our study design and results can be used as a starting point for quantitative studies in this field with a larger sample size and a controlled study design.

In addition to its strengths, our study also has limitations. The recruitment of patients from this vulnerable group was difficult because of concerns regarding their own abilities to operate a telemonitoring app; hence, the occurrence of a selection bias cannot be excluded. Moreover, some patients from this cohort dropped out of the overall study before the qualitative study started due to technical difficulties with the telemonitoring app examined. Finally, we included all 12 patients who met the inclusion criteria and agreed to be interviewed to achieve the greatest heterogeneity possible within our study sample. During the interview series, we noticed that the patients’ responses were repeated toward the end and we reached saturation concerning the topics addressed in the interviews with our available sample. However, it cannot be excluded that the inclusion of further patients with MCI would have opened other relevant topics. When interviewing study participants, there is always the possibility that their answers are influenced by social desirability, which in turn could lead to biased results. To tackle this issue, we opted for an open interview setting, gave the participants the chance to ask questions, and kept the number of people present during the interview to a minimum. In addition, recall bias can exist, particularly in the case of interviewing patients with MCI. Some patients did not adhere to the interview topics and talked about aspects subjectively perceived to be relevant. Hence, some questions remained unanswered or may have been answered inadequately (response bias). However, our study design and results provide a valuable basis for future studies with a larger sample size.

**Conclusions**

When continuous personal support was available right from the start of use and when the app was tailored in a needs- and disease-specific design, ensuring high perceived ease of use, the majority of examined patients with MCI were capable of operating the telemonitoring app independently. Hence, this study provides initial evidence that older patients with multimorbidity and MCI could increasingly be considered as a relevant user group for telemonitoring apps and should be involved as codesigners in their development. Future studies should investigate this issue further with a larger sample of patients with MCI.

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**Authors’ Contributions**

The overall study and the presented substudy focusing on patients with MCI were conceived and designed by VH, JS, DD, and MS. VH was in charge of the overall direction and planning of the study. CL supported the recruitment of general practitioners and study patients. The interview guideline was initially developed by MS, and discussed and consented to by the entire research team (all authors). The interviews were conducted by KA, DD, and MS. Data evaluation was carried out by MS, EL, DD, and KA. MS wrote the manuscript with considerable input from CL. All authors reviewed and commented on the final manuscript.
Conflicts of Interest
None declared. Unrelated to this project, JS received institutional funding from Sanofi, Novartis, ALK, and Pfizer for investigator-initiated research, and acted as a consultant for Lilly, Novartis, and Sanofi.

Multimedia Appendix 1
Interview guideline.

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Abbreviations

ATMoSPHAERE: Autonomy despite multimorbidity in Saxony through patient empowerment, holistic care for older people with networking of all regional institutions and service providers

MCI: mild cognitive impairment

MMSE: Mini-Mental State Examination

OECD: Organisation for Economic Co-operation and Development