

Digital Health Literacy and Tool Adoption in Post-Operative Care: A Mixed-Methods Analysis from a Safety-Net Hospital Population

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Digital Health Literacy and Tool Adoption in Post-Operative Care: A Mixed-Methods Analysis from a Safety-Net Hospital Population

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Abstract

Background: Digital health tools are increasingly prevalent in post-operative care management, yet limited research exists on digital health literacy and tool adoption among safety-net hospital populations. Understanding these factors is crucial for developing effective digital health solutions for historically underserved communities.

Objective: To evaluate digital health literacy, assess technology adoption readiness, and examine the relationship between patient-reported capabilities and demographic factors in a post-operative care context at a safety-net hospital.

Methods: We conducted a mixed-methods study with 71 post-operative patients and 29 healthcare providers. Participants completed a modified eHealth Literacy Scale (eHEALS) assessment and demographic questionnaire, followed by usability testing of a digital health prototype. Digital health literacy was evaluated using a 10-point Likert scale, and correlations between demographic factors and digital health literacy were analyzed.

Results: Despite common assumptions about technology barriers in safety-net populations, 69% of patients reported high confidence (score ≥3 on a 5-point scale) in finding health resources online, and 60.6% expressed confidence in using the internet for health-related questions. However, only 49.3% felt confident in using digital resources for health decision-making. Patient comfort with technology did not significantly correlate with age, but rather with prior technology exposure, with 78.9% reporting ≥10 years of digital device experience.

Conclusions: Digital literacy and health literacy have been studied in safety-net contexts, but there is a dearth of research on digital health literacy in post-operative care and safety-net populations specifically. Our findings suggest that digital health tools may be more feasible in safety-net settings than previously considered. However, the gap between patients' ability to find health resources and their confidence in using these resources for health decision-making highlights the need for targeted support in translating digital capabilities into healthcare management skills.

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1.

Introduction

Post-operative care increasingly relies on digital health tools to support patient recovery, manage symptoms, and facilitate provider-patient communication [1,2]. As healthcare systems transition toward digital solutions, understanding patients' ability to effectively engage with these tools becomes crucial, particularly in safety-net hospital settings where digital health literacy barriers may impact care delivery and outcomes [3]. Digital health literacy, defined as “the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem” [4], plays a vital role in successful implementation of digital health tools [2,5].

Evidence suggests digital tools are effective in improving disease outcomes and health literacy [6,7,8,9]. Mobile Health Applications (MHAs) in the postoperative period have been correlated with earlier discharge, reduction of in-person follow-ups [10,11], promotion of rehabilitation [12], earlier detection of surgical complications [13], and improved communication between patients and healthcare professionals [14,15]. Beyond these clinical benefits, postoperative monitoring apps have shown potential to empower patients, providing autonomy over their own health and potentially improving satisfaction and recovery motivation [16,17,18].

However, it remains unclear what factors make these digital tools superior to human health navigators or resources available through simple internet searches [19], particularly in post-operative settings [20]. Despite the proliferation of digital health tools in post-operative care [21], limited research exists on digital health literacy and technology adoption readiness among safety-net hospital populations [22,23]. While studies demonstrate the efficacy of mobile applications in improving post-operative outcomes [24], these benefits presume a baseline level of digital health literacy that may not be universal across all patient populations, particularly in historically underserved communities [25].

In safety-net hospital settings, health literacy is shaped by factors such as education, language, and socioeconomic status, with lower health literacy levels linked to poorer health outcomes, reduced treatment adherence, and greater reliance on emergency care. Digital literacy, while related, is a distinct construct that poses additional barriers—particularly for older adults, non-English speakers, and individuals from lower socioeconomic backgrounds—who often face limited internet access and lack the digital skills necessary for navigating healthcare tools and systems. These separate constructs highlight a need for tailored tools to improve both forms of literacy [26].

The assumption that patients in safety-net hospitals face significant barriers to digital health tool adoption has influenced both tool development and implementation strategies [23]. However, this assumption may not reflect current reality, as smartphone ownership and digital technology use have become increasingly prevalent across socioeconomic groups [27, 28]. Understanding the actual digital health literacy levels and technology adoption readiness of safety-net hospital patients is essential for developing and implementing effective digital health tools [29].

In this paper, we present Pocket-Doc, an app designed to support post-operative patient care, and through its evaluation, we provide data on digital health literacy among post-operative patients at a safety-net hospital. We also assess technology adoption readiness and examine relationships between patient-reported capabilities and demographic factors. Through a mixed-methods approach combining a modified eHealth Literacy Scale (eHEALS) assessment [30] with usability testing of a digital health prototype, we aim to challenge traditional assumptions about digital health literacy barriers and identify opportunities for more effective digital health tool implementation in post-operative care.

Materials and Methods:

2.1. Study Design and Setting

The research was conducted at a large safety-net hospital in a Southern US state and approved by the Institutional Review Board (IRB #STUDY00004346). We employed a mixed-methods approach combining quantitative assessments of digital health literacy with a qualitative usability testing of a digital health prototype.

2.2. Study Population and Recruitment

Participants included 71 post-operative patients and 29 healthcare providers. Study inclusion criteria required participants to be adults (≥ 18 years) who either had surgery within the past year, were caretakers of someone who had surgery in the past year or provided clinical care in the post-surgical period. Participants were not excluded based on health status, gender, race, or socioeconomic status, though patients with cognitive deficits or functional impairments preventing the use of digital devices were not recruited.

2.3. Digital Health Literacy Assessment

Participants completed a modified version of the eHealth Literacy Scale (eHEALS), a validated instrument for measuring individuals' combined knowledge, comfort, and perceived skills at finding, evaluating, and applying electronic health information [30]. The modified eHEALS included seven of the original eight items using its standard 5-point Likert scale (1='not at all confident' to 5='completely confident'). It should be noted that one question from the original eHEALS instrument was inadvertently omitted during survey implementation. We proceeded with analysis of the collected data while acknowledging this limitation in our interpretation of results.

2.4. PocketDoc Development and Testing

Pocket-Doc is a comprehensive digital health tool designed to support patients during the postoperative period, particularly in historically underserved populations. Key functionality includes symptom tracking, medication management with reminders, secure messaging for communication with healthcare providers, and educational resources tailored to specific procedures. The platform also includes appointment scheduling, follow-up management, and real-time tools for assessing symptom burden, all aimed at enhancing recovery and improving patient outcomes.

These features were designed to accommodate varying levels of digital literacy, with particular attention to intuitive navigation and clear information presentation. The interface incorporated evidence-based design principles for healthcare applications [31], including consistent layout patterns, clear call-to-action elements, and simplified medical terminology. The development process included multiple rounds of iterative design and input from design professionals, business consultants, and historically underserved patients through multiple rounds of feedback.

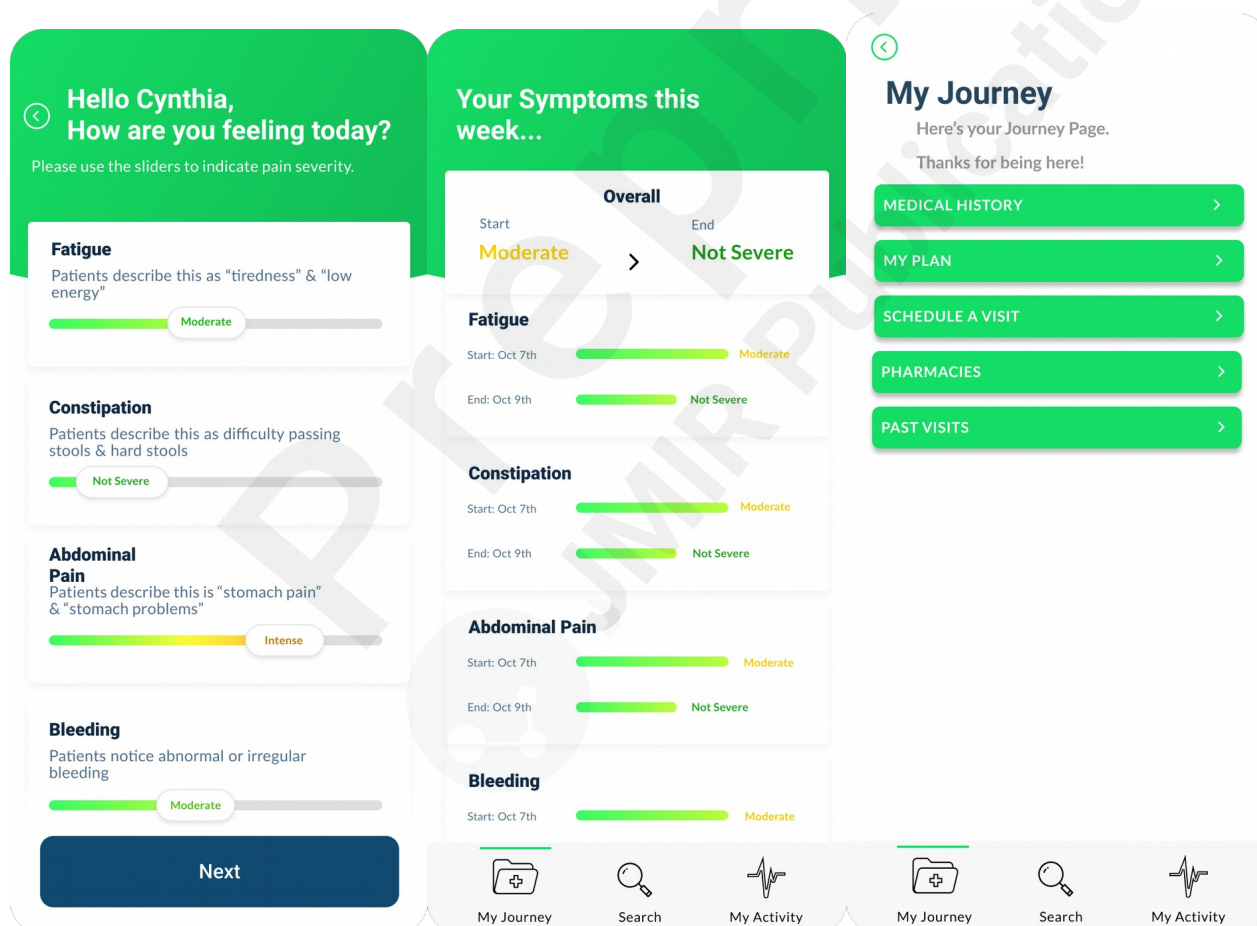


Figure 1: Select Photos of Intro Page and My Journey tab of Pocket-Doc

For the usability testing and post-task surveys, responses were collected using a 10-point Likert scale (1='strongly disagree' to 10='strongly agree') to obtain granular insights into participants' experiences with the digital health prototype.

2.5. Data Collection Procedures

Data collection occurred in two phases: The first phase included the demographic questionnaire, modified eHEALS assessment, and technology experience survey. The second phase was the usability test, including standardized introductions to tasks, think-aloud protocols during task completion, and a post-task survey [32]. Sessions were conducted either in-person or virtually via video conference to accommodate participant availability, with each session lasting approximately 20 minutes.

2.6. Data Analysis

Survey results were analyzed using the Kruskal-Wallis H test to examine differences in digital health literacy and tool adoption across geographic categories. Post-hoc Dunn-Bonferroni tests were conducted to examine rural-suburban and rural-urban comparisons in digital health literacy. Spearman's rank-order correlation was used for associations between patient-reported capabilities and using health resources, as well as relationships between technology experience and tool adoption. Descriptive statistics were calculated for demographic and survey data to characterize demographic and survey data.

3. Results

3.1. Participant Demographics

All 71 patients completed the modified eHEALS pre-survey and subsequent assessments. Patient demographics are presented in Table 1. We find that there is diverse representation across age groups, with approximately half between ages 18-34. Most participants came from urban (n=23) and suburban (n=43) environments, with limited rural representation (n=3). Most participants (57.7%) had undergone surgery within the last month, while 26.8% had surgery within 6 months, and 14.1% within the past year. Chronic conditions were reported by 57.7% of participants, indicating a population with ongoing healthcare needs.

Table 1: Demographic Characteristics of Study Participants (N=71)

<i>Characteristic and Category</i>	<i>Total (N=71)</i>	<i>Percentage</i>
<i>Survey Completion</i>		
eHEALS pre-survey	71	1
PocketDoc post-survey	71	1
<i>Time Since Surgery</i>		
Within the last month	41	0.577
Within 6 months	19	0.268
Within the past year	10	0.141

Chronic Conditions

Have chronic conditions	41	0.577
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No chronic conditions	27	0.38
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Number of Chronic Conditions (n=41)

One condition	23	0.561
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Two conditions	12	0.293
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Three conditions	6	0.146
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Age Group

18-24	14	0.197
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25-34	19	0.268
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35-44	9	0.127
-------	---	-------

45-54	7	0.099
-------	---	-------

55-64	12	0.169
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65-74	7	0.099
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75-84	3	0.042
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85 or older	0	0
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3.2.

Digital

Health

Literacy

Levels

Analysis of the modified eHEALS survey revealed that 69% of patients reported high confidence (score ≥ 3 on 5-point scale) in finding health resources online (mean=2.85, SE=0.091). Furthermore, 60.6% of participants expressed confidence in using the internet for health-related questions (mean=2.83, SE=0.108), and 63.4% reported feeling capable of evaluating health resources (mean=2.89, SE=0.099). However, a notable drop occurred when examining confidence in health decision-making, with only 49.3% feeling confident in using digital resources for making health decisions (mean=2.61, SE=0.113). Statistical analysis revealed significant positive correlations between patients' confidence in finding health resources and their satisfaction with the PocketDoc interface ($p=0.262$, $p=0.027$). Similarly, patients' confidence in using these resources showed a significant positive correlation with interface satisfaction ($p=0.304$, $p=0.010$).

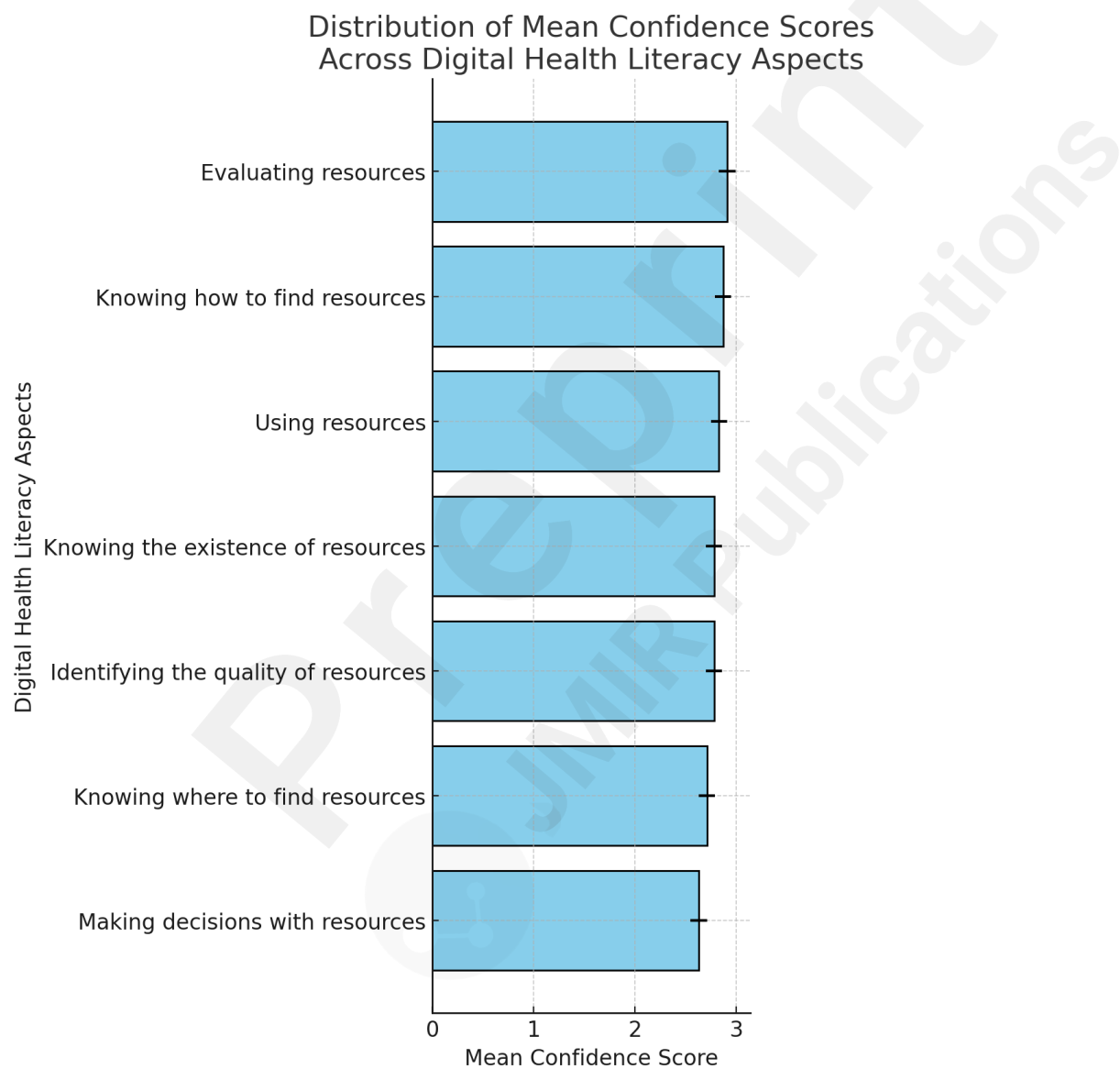


Figure 2: Patient-Reported Digital Health Literacy Scores by Domain

Table 2: Digital Health Literacy Scores by Domain

<i>Aspect</i>	<i>Mean</i>	<i>Median</i>	<i>Standard Error</i>
Evaluating resources	2.89	3	0.099
Knowing how to find resources	2.85	3	0.091
Using resources	2.83	3	0.108
Knowing the existence of resources	2.77	3	0.097
Identifying the quality of resources	2.77	3	0.114
Knowing where to find resources	2.7	3	0.121
Making decisions with resources	2.61	2	0.113

3.3. Technology Experience and Demographic Correlations

Analysis of technology experience revealed that 78.9% of participants reported ten or more years of digital device experience, indicating substantial familiarity with technology within the study population. Statistical analysis demonstrated no significant correlation between digital literacy and age or education level. However, geographic location emerged as a notable factor in digital literacy levels. The Kruskal-Wallis H Test revealed significant differences in perceptions based upon living environment ($p=0.050$, effect size=0.112). Urban and suburban patients reported similarly high mean confidence scores (9.00/10), while rural patients reported significantly lower scores (mean=7.00/10). Post-hoc Dunn-Bonferroni tests showed differences between rural-suburban ($p=0.081$) and rural-urban comparisons ($p=0.080$), though these narrowly failed to reject the null hypothesis.

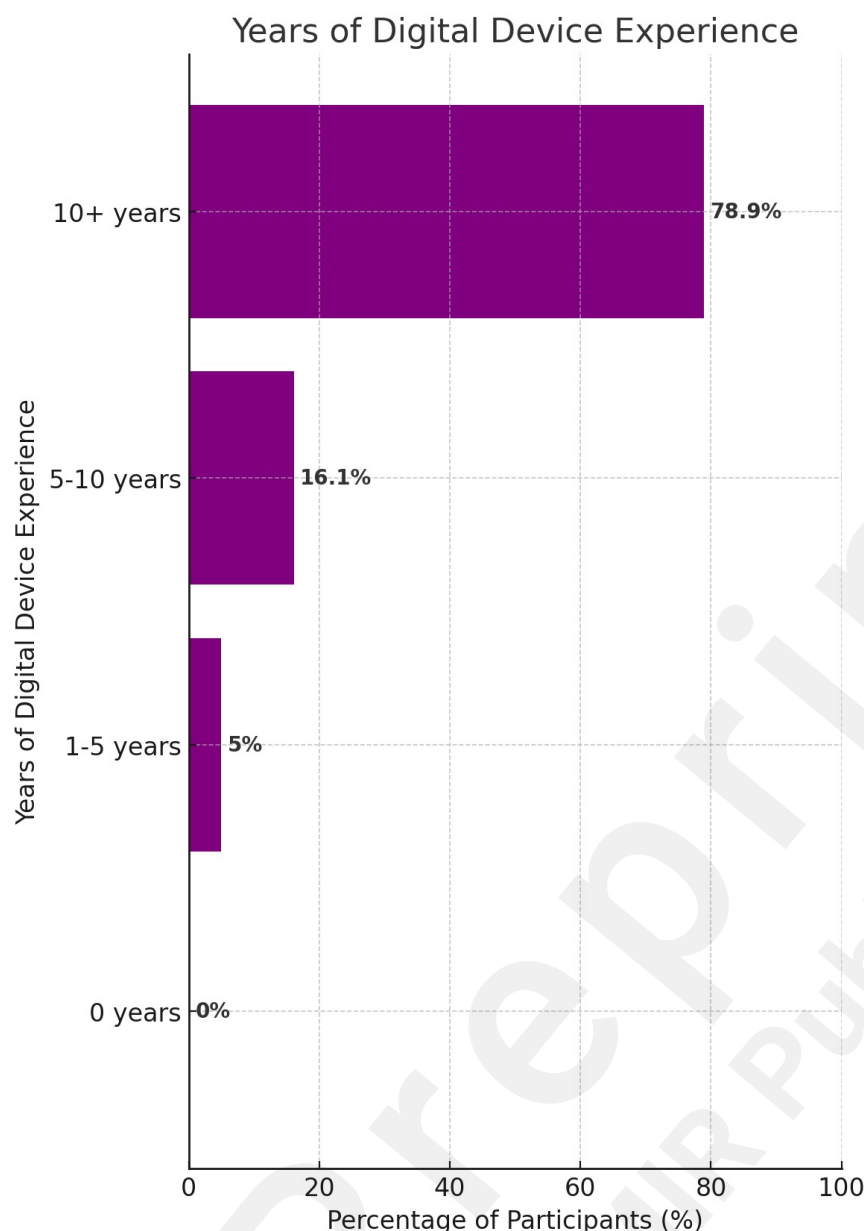


Figure 3: Years of Digital Device Experience Among Post-Operative Patients (n=71)

3.4. Tool Adoption and Usage Patterns

In the usability assessment of the digital health prototype, participants demonstrated high levels of engagement and capability. The combined usability score across all participants was 9.09/10 for ease of use (SD=1.277, SE=0.129), with task intuitiveness scoring 8.82/10 (SD=1.481, SE=0.150). Analysis revealed a significant correlation between prior technology exposure and perceived helpfulness of a digital health tool like Pocket-Doc ($p=0.23$, $p=0.041$). Participants with ≥ 10 years of digital device experience showed particularly strong performance in information-finding tasks (mean=8.48/10, SE=0.173, SD=1.712).

Interestingly, participants' ability to distinguish high-quality health resources showed a significant negative correlation with ease of finding information ($p=-0.251$, $p=0.035$), while the correlation with information organization perception was marginally significant ($p=-0.215$, $p=0.072$).

Table 3. PocketDoc Usability Scores and Patient Confidence Metrics

<i>Usability Metric</i>	<i>Survey Question</i>	<i>Mean Score</i>	<i>Standard Error</i>	<i>Median</i>
Ease of Use	I think PocketDoc was easy to use	9.1	0.15	10
Task Intuitiveness	Scenario I think the Task Scenarios were intuitive to complete with PocketDoc	8.77	0.182	10
Interface Satisfaction	I like the interface of PocketDoc	8.69	0.186	9
Information Findability	I think my health information was presented to me in a way that was easy to find	8.61	0.2	9
Information Organization	I think my health information was presented to me in a way that was well organized	8.18	0.2	8
Compassionate Wording	I think my health information was presented to me in a way that was worded compassionately	9.44	0.123	10
Information Summary	I think my health information was presented to me in a way that was useful for summary	8.68	0.172	9
Health Journey Support	I think PocketDoc would help me record my health journey after surgery	8.83	0.164	9
Patient Confidence	I am confident in my ability to use PocketDoc (as demonstrated)	9.42	0.12	10

4. Discussion

Digital health literacy and technology adoption in safety-net hospital populations present a more nuanced picture than traditionally assumed. Prior research has suggested that many patients in safety net hospitals face barriers to digital health tool adoption due to limited technology access, lower digital literacy, and poor health literacy [26]. Our findings challenge several common perceptions about digital health literacy barriers while highlighting specific areas where targeted support may be necessary for effective implementation of digital health tools in post-operative care.

The high level of general digital competency observed in our study population (69% reporting high confidence in finding health resources online) suggests that basic digital literacy may no longer be a primary barrier to digital health tool adoption in safety-net populations [26]. This finding aligns with recent trends showing increased smartphone ownership and digital technology use across socioeconomic groups [27]. The prevalence of participants with substantial technology

experience (78.9% reporting ≥ 10 years of digital device use) further supports this shift in the digital literacy landscape.

Particularly noteworthy is the specific pattern of digital health literacy we observed. While 63.4% of participants felt confident in evaluating health resources and 60.6% expressed confidence in using the internet for health-related questions, only 49.3% felt confident in health decision-making. This pattern aligns with previous research by Conard et al. [4] showing that digital health literacy encompasses multiple distinct competencies, with decision-making often emerging as the most challenging aspect. Similar findings have been reported in studies of chronic disease management [25,33] and general healthcare navigation [34], suggesting this may be a universal challenge in digital health tool implementation.

The significant drop between general digital competency (69%) and confidence in using digital resources for health decision-making (49.3%) mirrors findings from several recent studies [35, 36] that highlight the complexity of translating basic digital skills into healthcare management capabilities. This gap appears particularly pronounced in post-operative care settings, where decisions may have immediate health implications and where patients must often navigate complex care instructions [37].

Geographic variations in digital health literacy, while limited by our small rural sample size, point to potential disparities that warrant further investigation. The lower confidence scores among rural participants (mean=7.00/10 compared to 9.00/10 for urban/suburban) align with broader research on rural-urban digital health disparities [35]. These findings contribute to a growing body of evidence suggesting that geographic location may be a more significant determinant of digital health tool adoption than previously recognized [38].

The negative correlation between critical evaluation skills and satisfaction with information organization ($\rho=-0.251$, $p=0.035$) presents an interesting paradox that has been noted in other digital health literacy studies [39]. This finding suggests that as users become more sophisticated in their digital health literacy, their expectations for digital tools may become more demanding, a phenomenon also observed in studies of patient portals [40] and mobile health applications [41]. This dynamic creates a challenge for digital health tool implementation, as a one-size-fits-all approach may not satisfy users with varying digital literacy levels. This finding highlights the importance of adaptive design in post-operative digital health tools, as more sophisticated users might benefit from customizable filtering and displays. Future implementations should consider incorporating adaptable interfaces that present basic information to all users, while allowing access to advanced features and detailed data visualizations during their post-operative recovery.

While we collected additional qualitative data in the form of detailed interview transcripts and extended usability observations, the present paper focuses on quantitative analyses and usability themes. Further examination of the qualitative findings will be reported in a forthcoming manuscript, which will explore participants' nuanced experiences and perspectives in greater depth. This was done to allow for a more focused discussion of our key quantitative and usability outcomes.

4.1. Limitations

Several limitations should be considered when interpreting these findings. Our use of a modified eHEALS scale, which inadvertently omitted one question from the original validated instrument, may have affected the comprehensiveness of our digital health literacy assessment. This modification constitutes use of a non-validated tool; and while the modified version demonstrated internal consistency, the omission limits direct comparability with other eHEALS-based studies.

Our sample included limited representation from rural areas ($n=3$), which restricts our ability to draw robust conclusions about geographic disparities. This limitation is particularly relevant given the significant differences we observed between urban/suburban and rural participants.

The study's reliance on self-reported measures of digital health literacy may not fully capture actual capabilities. While self-reported measures are widely used in digital health literacy research [42], they may be subject to social desirability bias and over- or under-estimation of abilities. Our study may be subject to Berkson bias as those with extremely low digital literacy may be underrepresented in our sample if they were less likely to participate in a study involving digital tools, potentially leading to an overestimation of digital health literacy in the safety-net population.

5. Conclusions

This study advances our understanding of the evolving landscape of digital readiness among post-operative patients in safety-net settings. While participants reported substantial experience with digital devices, the data highlight a persistent

challenge: translating general digital familiarity into confidence in managing personal health decisions. This gap suggests that even when access and basic skills are present, patients may still struggle to apply digital tools meaningfully in complex clinical contexts such as post-operative care. Moreover, preliminary geographic trends point to location-based factors, rather than traditional demographic variables, as potential influences on confidence and engagement with digital health tools. These insights underscore the importance of designing tools that go beyond increasing access or general literacy, instead emphasizing support for decision-making and personalization based on patients' lived environments. Addressing these nuanced barriers may be key to optimizing digital health strategies and ensuring equitable post-operative support across diverse care settings.

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