ORIGINAL RESEARCH

Barriers and Enablers to the Use of Web-Based Applications for Older Adults and Their Caregivers Post-Hip Fracture Surgery: A Descriptive Qualitative Study

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Purpose: The purpose of this study was to describe the barriers and enablers to the use of web-based applications designed to help manage the personalized needs of older adults and their caregivers post-hip fracture surgery while transitioning from hospital to geriatric rehabilitation to home.

Methods: This was a descriptive qualitative study consisting of semi-structured interviews informed by the Theoretical Domains Framework. The study took place between March 2021 and April 2022 on an orthopaedic unit in a large academic health sciences centre and in a geriatric rehabilitation service in Ontario, Canada. The transcripts were analyzed using a systematic 6-step approach.

Results: Interviews were conducted with older adults (n = 10) and with caregivers (n = 8) post-hip fracture surgery. A total of 21 barriers and 24 enablers were identified. The top two barriers were a need for basic computer skills (n = 11, 61.1%) and a preference for direct verbal communication (n = 10, 55.6%). The top two enablers were having no concerns with using web-based applications (n = 12, 66.7%) and having ease of access to information (n = 10, 55.6%).

Conclusion: We described the key barriers and enablers to the use of web-based applications from the perspectives of older adults and their caregivers. These factors will inform further developments of web-based applications aimed at improving the care transition from hospital to geriatric rehabilitation to home post-hip fracture surgery.

Keywords: hip fracture, digital health intervention, web-based application, TDF, older adults

Background

Experiencing a hip fracture is often an alarming and life-altering event in the lives of older adults and their families. Hip fractures are associated with high mortality and morbidity rates, as well as reduced activity level, persistent fear of falling, and increased isolation.[1,2] Following hip fracture surgery, many care interventions across multiple health care settings are initiated.[1,3] These can include screening for delirium, deep vein thrombosis, pressure wounds and osteoporosis, as well as rehabilitation interventions (ie physiotherapy, occupational therapy) geared toward regaining pre-fracture function.[1]

Given the complex set of interventions post-hip fracture, it is of little surprise that patients and their families report feeling insecure and uncertain of what they can expect after a hip fracture.[4,5] The exchange and integration of information can be especially difficult for patients given the shock of the accident, the surgical procedure, and the fast-paced interactions with team members in hospital and rehabilitation centers.[5] Furthermore, older adults with a hip

fracture may have a diagnosis of cognitive impairment resulting in a reduction in how they process and retain the information.[6] Verbal instructions, especially, are likely not retained correctly.[7] Caregivers are often key to supporting hip fracture patients during the transition from hospital to geriatric rehabilitation to home.[8] Yet, caregivers may also feel overwhelmed, and unsure of how to provide support after a hip fracture.[5] However, both patients and caregivers report a strong desire to take charge of their situation and to be actively involved in their recovery.[4] Providing opportunities for engagement in managing one's care, and empowering hip fracture patients and their caregivers through better access to relevant health care information such as patient education, discharge information, and reminders for required follow-ups have been identified as priorities for this population.[5]

Digital health interventions have the potential to optimize the quality of communication and accessibility of information for stakeholders in health care settings, thereby empowering patients and their caregivers in the management of their care.[9,10] Digital health interventions are defined by the World Health Organization as "a discrete functionality of digital technology that is applied to achieve health objectives" (p.iii).[9] According to a recent scoping review of digital health interventions, they are most often utilized for the transmission of health information, receiving real-time support from care providers, personal health tracking, remote healthcare services, and peer support.[11] Digital health interventions, specifically web-based applications, have been used successfully to facilitate and optimize interdisciplinary care for a variety of patients including those with cardiac disease,[12,13] diabetes,[14,15] and other chronic conditions.[16,17] Specifically for hip fracture patients, web-based applications can improve education and information comprehension, quality of life, psychological wellness and support the return to pre-fracture fitness levels.[18,19]

Despite the potential benefits of web-based applications, factors related to capability, access, motivation, and other individual circumstances of patients and their caregivers can impact the successful use of these interventions.[20] Low uptake of technology interventions, specifically by older adults who have experienced a hip fracture may be related to decreased self-efficacy, lack of familiarity with technology, or acceptability of such interventions.[21] Yet, the feasibility of web-based applications with older adults has been previously demonstrated,[22,23] especially by using a holistic, integrative approaches that include the active participation of patient networks including caregivers and care providers.[20]

The purpose of this study was to describe the barriers and enablers to the use of web-based applications designed to help manage the personalized needs of older adults and their caregivers post-hip fracture surgery while transitioning from hospital to geriatric rehabilitation to home. This work will help inform further development of a web-based application, *MyPath to Home*.[24]

Methods
Study Design and Setting
This was a descriptive qualitative study consisting of semi-structured interviews guided by the Theoretical Domains Framework (TDF).[25] This study took place between March 2021 and April 2022 in an orthopaedic unit in a large academic health sciences centre and a geriatric rehabilitation service in Ontario, Canada. Research Ethics Board (REB) approvals were obtained prior to the start of the study. This study complied with the principles of the Declaration of Helsinki.

Theoretical Framework
We chose to explore implementation research and identified the TDF as a robust and interactive framework, useful for behaviour change research.[25] The TDF includes 14 theoretical domains synthesizing 33 behaviour change theories.[26–28] The TDF and its specific domains have been validated for use in implementation and behaviour change studies.[29]

For our study, we described the behaviour in terms of the target, action, context, time actor (TACT-A) principle[30] as follows: target (older adults and their caregivers post-hip fracture surgery), action (use of web-based applications to help manage their personalized needs), context (hospital, geriatric rehabilitation, and home), time (entire episode of care), and actor (hip fracture patients and caregivers). We developed similar but separate interview guides for geriatric hip fracture patients and for caregivers.

Eligibility Criteria

We used a convenience sampling technique to recruit hip fracture patients and caregivers. Patients were eligible to participate based on the following criteria: (a) post-hip fracture surgery, (b) > 65 years of age, (c) able to consent to participate. Patients with aphasia, significant cognitive impairment or receiving palliative care were excluded.

Caregivers were eligible if they were: (a) caring for a patient who had a hip fracture surgery, (b) $\geq$18 or older.

Recruitment and Data Collection

A designated person from the clinical care areas helped with the recruitment of the study participants. Individuals who expressed an interest in participating were asked to contact a trained research assistant who then further explained the study. After written or verbal informed consent was obtained (as approved by REB), audio recorded 30-minute semi-structured interviews following an interview guide took place either in person, by videoconference or by phone.

Data Analysis

Descriptive statistics were used to summarize the characteristics of the participants. Interviews were transcribed verbatim, and interviews were analyzed using a 6-step approach.[31] First, two research assistants (YM, SH) independently coded the transcripts according to the relevant domains of the TDF. Any discrepancies were resolved through discussion until consensus was met. Second, specific belief statements were generated for the coded segments of text. Third, similar belief statements were grouped together. Fourth, themes were generated inductively from the grouped belief statements (defined as a similar statement mentioned by two or more individuals). Fifth, each theme was classified as either a barrier or an enabler to using web-based applications. Sixth, themes were examined and the most frequent barriers and enablers specific to patients or to caregivers (reported by greater than 50%), as well as conflicting barriers and enablers, were identified. Frequency scores were calculated for the number of participants describing each barrier and enabler. Qualitative data analysis software (NVivo, QSR International Pty Ltd. Version 12) was used for data management.

Results

Patients and Caregivers' Demographics

A total of 18 participants, including 10 patients and 8 caregivers were recruited based on the inclusion criteria previously described. Most patients were female (n=7) and were between the age of 75 and 84 (n=6). With regards to caregivers, an equal amount of male (n=4) and female (n=4) caregivers participated. Caregivers were aged between 45 and 84 years old, with the majority between 45–54 (n=3) or 65–74 (n=3) years of age. Caregivers were most often children (n=6) of the patient; however, spouses (n=2) were also included. Further details are provided in Table 1.

Patients' and Caregivers' Barriers

A total of 21 barriers were identified. The top barriers, which were identified by more than 50% of the participants, were a need for basic computer skills (n=11, 61.1%), and a preference for direct verbal communication (n=10, 55.6%). These barriers were expressed by both patients and caregivers.

The most frequent barriers voiced by patients, identified by more than 50% of the patients, were the preference for direct verbal communication (n=8, 80%), the need for basic computer skills (n=7, 70%), a lack of confidence with the use of web-based applications (n=6, 60%), the inability to use web-based applications due to age (n=6, 60%), and not finding the use of web-based applications important (n=6, 60%). No specific barriers were identified by more than 50% of the caregivers. Details of the complete list of barriers as well as example quotes are provided in Table 2.

Patients' and Caregivers' Enablers

A total of 24 enablers were identified. The top enablers, identified by over 50% of the participants, were having no concerns with using web-based applications (n=12, 66.7%) and having ease of access to information (n=10, 55.6%). These enablers were also expressed by both patients and caregivers.

Table 1 Demographic Information
(Patients and Caregivers)

	Participants
Patients (N=10)	**n(%)**
Age	
65–74	1(10%)
75–84	6(60%)
85+	3(30%)
Gender	
Female	7(70%)
Male	3(30%)
Caregivers (N=8)	
Spouse	2(25%)
Child	6(75%)
Age	
45–54	3(37.5%)
55–64	0 (0)
65–74	3(37.5%)
75–84	1(12.5%)
Unknown	1(12.5%)
Gender	
Female	4(50%)
Male	4(50%)

The most frequent patients' enabler was no specific concerns or worries with using web-based applications (n=6, 60%). While no barriers were identified by more than 50% of the caregivers, a few enablers were identified, the most frequent being the caregivers' intention to use web-based applications (n=8, 100%). Other frequent enablers included confidence with the use of web-based applications (n=7, 87.5%), the straightforward process to use web-based applications (n=7, 87.5%), the importance of using web-based applications (n=7, 87.5%), no concerns with the use of web-based applications (n=6, 75%), anticipating benefits of ease of access to information (n=6, 75%), and not anticipating any negative aspects to the use of web-based applications (n=6, 75%). Details of the enablers are provided in Table 3.

Conflicting Themes
Several themes (n=5) were identified as both a barrier and an enabler. Some participants expressed a lack of confidence with the use of web-based applications (barrier) (n=6 patients, n=1 caregiver), while others were confident in using them (enabler) (n=4 patients, n=7 caregivers). Some participants found web-based applications not important to use (barrier) (n=7 patients) whereas others felt that they were important (enabler) (n=3 patients, n=7 caregivers). Some participants described having competing tasks or time constraints to using web-based applications (n=2 patients, n=2 caregivers) while others had no competing tasks or time constraints (enabler) (n=4 patients, n=3 caregivers). A few participants found that using web-based applications is not a straightforward process (barrier) (n=3 patients) whereas most found the

Table 2 Barriers to the Use of Web-Based Applications

Belief Statement	Total (Patients/ Caregivers) (N=18) n (%)	Patients (N=10) n (%)	Caregivers (N=8) n (%)	TDF Domains	Example Quote
I need basic computer skills	11 (61.1%)	7 (70%)	4 (50%)	Skills	I would say sort of basic computer skills, like to be able to log in, to provide a password, some basic Windows navigation in terms of, you know, clicking on links
I prefer direct verbal communication	10 (55.6%)	8 (80%)	2 (25%)	Goals	A higher priority? Someone who would check in on me, yeah, some– a person, a real person who would contact me to find out if I were having problems.
I get frustrated when using web-based applications	7 (38.9%)	5 (50%)	2 (25%)	Emotions	How frustrated I get [with web-based applications]. Once I get frustrated, I prefer to phone or have things in writing.
I lack confidence with the use of web-based applications*	7 (38.9%)	6 (60%)	1 (12.5%)	Belief about capabilities	I am very careful when I use anything like, like this [web-based applications]. I do not, I am not very good, you know.
I do not find web-based applications important to use*	7 (38.9%)	7 (70%)	0	Goals, Beliefs about capabilities	At this point it's not important at all because I have not seen it and I do not know. I do not know what benefit it would be to me.
I need access to a device	6 (33.3%)	4 (40%)	2 (25%)	Environmental context and resources	There are many people that do not have a computer, you know. So that would be a negative aspect, I think.
I believe that I am not able to use web-based applications due to my age	6 (33.3%)	6 (60%)	0	Social/ professional role and identity, Beliefs about capabilities, Skills	If I could, it would be lovely to have it [a web-based application] on my telephone. But I cannot. Not at this age.
I am aware that there could be risks associated with the security of the personal information on web-based applications	5 (27.8%)	2 (20%)	3 (37.5%)	Beliefs about consequences	I mean potential negative, you know, there's always the risk of personal information being accessed incorrectly. So, you know, certainly having a secure, internet security practices are important. So certainly, there could be some risk to personal information.
I do not like not being able to find information on web-based applications	5 (27.8%)	3 (30%)	2 (25%)	Emotions	When I need some information and I cannot find it [evokes worry or concern].
I do not like web-based applications that are difficult to navigate	5 (27.8%)	1 (10%)	4 (50%)	Emotions	Honestly, the only answer I can come up with is if it is a terrible website to navigate. If you cannot find the information you are looking for, if you are constantly, you know, having to change passwords, those type of things that I find are a big deal.
I may need some training to use web-based applications	5 (27.7%)	4 (40%)	1 (12.5%)	Skills, Social/ professional role and identity, Reinforcement	I think what will support is you know just to address [.] all the, the older people with some training. By training I mean some exposure to know how to use computer applications in general.
I have competing tasks or time constraints to using web-based applications*	4 (22.2%)	2 (20%)	2 (25%)	Environmental context and resources	Yeah, I always have time constraints.

(Continued)

Table 2 (Continued).

Belief Statement	Total (Patients/ Caregivers) (N=18) n (%)	Patients (N=10) n (%)	Caregivers (N=8) n (%)	TDF Domains	Example Quote
I do not find using web-based applications a straightforward process*	3 (16.7%)	3 (30%)	0	Memory, attention and decision processes, Beliefs about capabilities	I have to think about it. [deciding to use web-based application]
I have no intention to use web-based applications*	3 (16.7%)	3 (30%)	0	Intention	No. [I do not intent to use web-based applications]
I anticipate potential reliability issues with technology	3 (16.7%)	3 (30%)	0	Beliefs about Consequences, Environmental context and resources	Any time you are using anything technical there's potential for problems.
My memory can impact the use of web-based application	2 (11.1%)	1 (10%)	1 (12.5%)	Memory, attention and decision processes, Skills	You know, I think as long as they support sort of, you know, password, user ID recovery, that seems to be the biggest issue I know with my mother and other people is just remembering logins
I prefer paper-based information	2 (11.1%)	2 (20%)	0	Goals	Everything on a piece of paper. Pieces of paper.
I have a poor-quality device which can negatively affect the use of web-based applications	2 (11.1%)	1 (10%)	1 (12.5%)	Environmental context and resources	The quality of my machine, of my tablet or my computer. My tablet now is quite old and it loses things.
I need practice to use web-based applications	2 (11.1%)	2 (20%)	0	Skills, Belief about capabilities	Hours spent playing with the computer. [would help me overcome this difficulty of using web-based applications]
I do not anticipate that any resources could help with using web-based applications	2 (11.1%)	2 (20%)	0	Environmental context and resources	I doubt very much. [no resources would make it easier for me]
I have a lack of experience using web-based applications	2 (11.1%)	2 (20%)	0	Skills, Social/ professional role and identity	I am not using computer applications and things like that, I am very, very, you know, years before all of this.

Note: *Conflicting themes.

process straightforward (enabler) (n=5 patients, n=7 caregivers). Some participants described having no intention to use web-based applications (barrier) (n=3 patients), while others have the intention to use them (enabler) (n=5 patients, n=8 caregivers).

Discussion

We identified 21 barriers and 24 enablers to the use of web-based applications for older adults and their caregivers post-hip fracture surgery. Our findings indicate that both patients and caregivers voiced similar concerns with the use of web-based applications including the need for basic computer skills (n=11, 61.1%), and a preference for direct verbal communication (n=10, 55.6%). They also shared top enablers such as having no concerns with using web-based applications (n=12, 66.7%) and having ease of access to information (n=10, 55.6%).

When considering patients and their caregivers separately, we found that patients reported more barriers and less enablers to the use of web-based applications, whereas caregivers more frequently reported enablers rather than barriers. Given, the higher age range of participant patients (ie, all patients (n=10) were over the age of 65 as per the eligibility

Table 3 Enablers to the Use of Web-Based Applications

Belief Statement	Total (Patients/ Caregivers) (N=18) n (%)	Patients (N=10) n (%)	Caregivers (N=8) n (%)	Domains	Example Quote
I intend to use web-based applications*	13 (72.2%)	5 (50%)	8 (100%)	Intention	I would absolutely, yes. [use web-based applications]
I find the process straightforward when deciding to use a web-based application*	12 (66.7%)	5 (50%)	7 (87.5%)	Memory, attention and decision processes, Beliefs about capabilities	I do not have to think about it a lot, no. [to use web-based applications]
I am not concerned or worried about using web-based applications	12 (66.7%)	6 (60%)	6 (75%)	Emotions	No. [using web-based applications does not evoke worry or concern]
I am confident with the use of web-based applications*	11 (61.1%)	4 (40%)	7 (87.5%)	Beliefs about capabilities	Very easy. [for me to use web-based applications]
I anticipate having ease of access to information	10 (55.6%)	4 (40%)	6 (75%)	Beliefs about consequences	Well, I would think that the organization can see how the patient is progressing and, you know, the patient can see how they are progressing and the caregiver, if they have any questions, or, you know, are not sure, you know, lost the piece of paper of what exercises need to be done and cannot remember something, and they can hop on a website to show them what, you know, the patient should be able, or should be doing, I think that would be extremely beneficial.
I feel using web-based applications is important*	10 (55.6%)	3 (30%)	7 (87.5%)	Goals	Oh, I would say 10. [importance to use web-based applications on the scale of zero to ten, with ten being the most important]
I do not anticipate any negative aspects to using web-based applications	9 (50%)	3 (30%)	6 (75%)	Beliefs about Consequences, Optimism	I do not know if there's any negativity in providing education for anything like that. I do not see any negativity, like myself anyway.
I anticipate the use of web-based applications to be very beneficial	8 (44.4%)	5 (50%)	3 (37.5%)	Beliefs about consequences	If you can use the web properly, it's very beneficial.
I have no competing tasks or time restraints to the use of web-based applications*	7 (38.9%)	4 (40%)	3 (37.5%)	Environmental context and resources	No. [competing tasks or time constraints that influence my use of web-based applications]
I feel that a web-based application would provide a written record of information which is an incentive	7 (38.9%)	3 (30%)	4 (50%)	Reinforcement, Beliefs about consequences	I like the ability to put things in and to record things or to look at what's going on. So that would be fine.
I have social support to use web-based applications	7 (38.9%)	4 (40%)	3 (37.5%)	Social influence, Beliefs about capabilities	I get stuck and if that happens, I ask either my son or daughter for their help.
The availability of web-based applications is important to me	6 (33.3%)	3 (30%)	3 (37.5%)	Reinforcement, Environmental context, and resources	You know, how available is it, like are there, are there times when the access might be denied or restricted or, you know, so I'd want to make sure that it was available 24/7 if possible.
I have a positive social influence to use web-based applications	6 (33.3%)	5 (50%)	1 (12.5%)	Social Influence	Yes. Just encouragement. [my family's influence on my approach with web-based applications]

(*Continued*)

Table 3 (Continued).

Belief Statement	Total (Patients/ Caregivers) (N=18) n (%)	Patients (N=10) n (%)	Caregivers (N=8) n (%)	Domains	Example Quote
I need my information to be personalized and readily accessible	6 (33.3%)	4 (40%)	2 (25%)	Reinforcements	Well, that they, that they are updated. You know that they are personalized. That they are available when you need them. All of those things. [to ensure consistent use of web-based applications]
I anticipate that the web-based applications will facilitate communication with health care providers	5 (27.8%)	1 (10%)	4 (50%)	Beliefs about consequences	It's in helping the providers to explain or make the persons understand better the problems and solutions of what, of what they are facing.
I feel positive about using web-based applications	4 (22.2%)	2 (20%)	2 (25%)	Emotions, Optimism	Other than it being a good thing, no.
I anticipate benefits to health care providers for ease of access to information when using web-based applications	4 (22.2%)	3 (30%)	1 (12.5%)	Beliefs about Consequences	It should be of benefit for the health care provider because it would be easily accessible. Easier than going to [the] file in an office. I think. Yeah. I think that would be a benefit for [them].
I would like assistance readily available for the web-based applications	4 (22.2%)	1 (10%)	3 (37.5%)	Environmental context and resources, Reinforcement	Well, I suppose if help was available. If help was available, readily available. That would be good.
I would be more confident in discharge outcomes using web-based applications	3 (16.7%)	0	3 (37.5%)	Beliefs about Consequences	Where I am a little, little more concerned right now. But if I had that tool [a web-based application], I feel like I would, myself and my father, would both feel way more confident in her coming home.
I feel that written instructions would make a web-based application easier to use	3 (16.7%)	1 (10%)	2 (25%)	Environmental context and resources	Maybe having step-by-step instructions written out how to use the app and how to look for information.
I anticipate web-based applications to be more efficient and consistent	2 (11.1%)	1 (10%)	1 (12.5%)	Beliefs about consequences	I would probably be more interested in web-based applications because I am hoping it would be more efficient and more consistent.
I think familiarity with web-based applications from workplace setting will influence the use of web-based applications	2 (11.1%)	2 (20%)	0	Beliefs about capabilities	I would say I am more, maybe more familiar than other people in the sense that I work in the software industry.
I am curious about web-based applications	2 (11.1%)	2 (20%)	0	Emotions	Maybe my curiosity to understand these things. [influences my use of web-based applications]
I anticipate bothering less the healthcare providers when using web-based applications	2 (11.1%)	2 (20%)	0	Beliefs about consequences	They'd be bothered less. [benefits of using web-based applications for the health care provider]

Note: *Conflicting themes.

criteria) compared to caregivers (ie, caregivers (n=3) were under the age of 55), this finding is congruent with studies' results showing increasing barriers to technology with age.[32] However, although the caregivers in our study were generally younger than patients, four were over the age of 65 which may explain why they voiced similar top barriers.

With regards to patients specifically, the most frequently reported barrier was the preference for direct verbal communication (n=8, 80%). The preference for face-to-face communication has been reported by patients in similar studies examining the use of digital health interventions by older adults.[20,21,33] However, studies examining the effectiveness of

different modes of communication in healthcare settings, have found that verbal instructions are often remembered incorrectly, if at all, by patients.[7] Indeed, participants in our study (n=3 patients, n=4 caregivers) identified the opportunity for written instructions in the web-based application as an incentive to use, and described web-based applications as having the potential to improve overall communication with their healthcare providers (n=1 patient, n=4 caregivers).

Overall, patients more frequently expressed belief statements indicating low motivation for using web-based applications than caregivers, such as not finding web-based applications important to use (n=7, 38.9%), and having no intention of using a web-based application (n=3, 16.7%). Morris et al[21] found that acceptability and uptake of digital technology by older adults with hip fractures were negatively impacted by low self-efficacy and lack of familiarity with technology. Indeed, three of the most important barriers for patients were the need for basic computer skills (n=7, 70%), a lack of confidence with the use of web-based applications (n=6, 60%), and the belief that one is unable to use web-based applications due to age (n=6, 60%). All these barriers fell within the TDF domains of skills and beliefs about capabilities, which was congruent with studies reporting low health literacy, low self-efficacy and a belief that age plays a major factor in being unable to use technology as being significant barriers for older adults.[18,20,34–36]

Stereotypes that depict all older adults as unable to use technology negatively impact the social participation of older adults and fail to pick up on nuances between individuals that can be addressed to improve digital participation.[36] Although many older adults have lower baseline computer skill levels, many factors such as low confidence and anxiety surrounding technology can be addressed successfully through training and caregiver support.[36]

Supportive caregivers have been identified as key to successful transitions from acute care, to rehabilitation, to home,[8] and specifically for using digital health interventions.[37] Similarly, in this study, patients and caregivers described having social support to use web-based applications (n=7, 38.9%) and having a positive social influence to using web-based applications (n=6, 33.3%). Other studies have also shown that support from caregivers is crucial.[38–40]

The results of this study will inform further development of *MyPath to Home*,[24] a web-based application to support older adults and their caregivers as they manage their personalized needs during their transition from the hospital, to rehabilitation, to home. Specifically, the barriers and enablers analysis will inform the intervention strategy. We will select the evidence-based behaviour change techniques (BCTs)[27] that align with the barriers and enablers identified in this study. For example, some of these BCTs to tackle the two top barriers will include training on basic computer skills and the use of incentives for patients and caregivers to access a combination of direct verbal communication from providers with supplemental web-based (including video and written) information. These BCTs will be incorporated in the next iteration of *MyPath to Home*[24] intervention for evaluation in a future research study.

Strengths and Limitations

Overall, this study has several strengths and limitations. It was guided by the TDF framework which was used for data collection and analysis. Our recruitment was slow due to the COVID outbreaks experienced on the study units. Although our sample size was relatively small, our study included both the patients and caregivers' perspectives. It is possible that those who refused to participate were even more unfamiliar with web-based applications. Further studies should also be conducted to understand the barriers and enablers from the providers' perspectives and how these web-based applications may affect their work processes.

Conclusion

This study identified the key barriers and enablers to the use of web-based applications from the perspectives of older adults and their caregivers. This research will directly inform how web-based applications can be incorporated into everyday clinical practice to help improve care transition experience, preparedness for discharge, and coping after discharge for older adults and their caregivers post-hip fracture surgery. It can also improve system efficiencies (such as readmissions, and sub-optimal care leading to complications), optimizing the transitions between health care sectors. By addressing the barriers and leveraging the enablers identified, we may see the benefits of tailoring web-based applications to meet the needs of patients and their caregivers as well as improve the uptake of these digital health interventions.

Data Sharing Statement

No additional data are available.

Ethics Approval and Consent to Participate

Approval was obtained from the Ottawa Health Science Network Research Ethics Board (#20180469-01H), the Bruyère Continuing Care Research Ethics Board (#M16-18-03) and the University of Ottawa Health Sciences and Sciences Research Ethics Board (#H-08-18-1061).

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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