Pilot and Feasibility Studies

RESEARCH

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Feasibility, acceptability, and preliminary effects of PATH FOR timely transfer of geriatric HIP fracture patients from hospital to rehabilitation to home (PATH4HIP): a mixed methods study

Chantal Backman[1,2,3*], Anne Harley[4], Steve Papp[5], Colleen Webber[3], Stéphane Poitras[6], Paul E. Beaulé[7] and Veronique French-Merkley[4]

Abstract

Background Hip fractures represent sentinel events in older adults' lives that can lead to a loss of function and permanent disability. Our team developed an evidence-based pathway intervention: PATH FOR timely transfer of geriatric HIP fracture patients from hospital to rehabilitation to home (PATH4HIP). The goal of the pathway is to facilitate early transfer of hip fracture patients to geriatric rehabilitation without having a negative impact on their rehabilitation outcomes. The purpose of this study was to pilot PATH4HIP with post-operative geriatric hip fracture patients during their transition from hospital to rehabilitation to home.

Methods We conducted a mixed methods feasibility study using the RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) framework to evaluate the feasibility, acceptability, and preliminary effects of PATH4HIP. Quantitative data were accessed through administrative databases, and qualitative data were collected from patients, caregivers, and clinicians to report on the five RE-AIM domains.

Results A total of 317 hip fracture patients were screened between January and September 2022, and 152 met the study eligibility criteria. *Reach* was achieved, with 77.0% of eligible patients ($n=117$) agreeing to participate (progression criteria of ≥ 75.0%). *Effectiveness* outcomes including rehabilitation length of stay, functional gains, discharge to the community, and 30-day emergency department return rates were comparable to previously reported data for this population. *Adoption* was also high, with 76.9% of enrolled patients ($n=90$) completing the pathway. *Implementation* was carried out with minimal protocol variations; however, only 48.9% of patients ($n=44$) were discharged from acute care by post-operative day 6 (progression criteria of ≥ 75.0%), falling short due to challenges associated with the COVID-19 pandemic. Finally, participants indicated that the PATH4HIP intervention was acceptable, supporting its *Maintenance*.

Conclusion The study confirmed the feasibility and acceptability of the pathway, while key rehabilitation outcomes were not negatively affected. This pathway design prioritized best practices for hip fracture care and collaboration

*Correspondence:
Chantal Backman
chantal.backman@uottawa.ca
Full list of author information is available at the end of the article

across health care sectors. This intervention was low cost as it used existing resources to improve use of surgical beds, while enhancing post-surgery hip fracture care. Further research is needed to examine the implementation of this intervention on a larger scale.

Keywords Hip fractures, Geriatric rehabilitation, Feasibility studies

Key messages regarding feasibility

- It is uncertain whether it is feasible to implement a pathway that will facilitate early transfer of hip fracture patients to geriatric rehabilitation without having a negative impact on their rehabilitation outcomes.
- This study confirmed that PATH4HIP was feasible and acceptable, while patients' rehabilitation outcomes were not negatively affected.
- The results of this study support the need for further evaluation of PATH4HIP.

Background

Hip fractures have been described as a significant public health issue [1, 2], especially in the context of our aging population. The incidence of hip fractures increases with age [3], and hip fractures are the most common type of fracture among adults over 80 [4]. Hip fractures are associated with high mortality [4], significant functional decline [4], and are costly to the health care system [5, 6]. The economic cost of hip fractures in Canada is estimated to reach 2.4 billion annually by 2041 [7, 8].

Every year in Ontario, approximately 13,000 people experience a hip fracture [2, 4]. Despite the development of evidence-based recommendations for the care of older adults with hip fractures, concerns regarding the variability in patient outcomes and quality of care post-hip fracture have been voiced by provincial [2] and national [7] health institutions, prompting the development of standardized clinical pathways. Clinical care maps or pathways can help successfully integrate the best evidence and quality standards into hip fracture care transitions. Quality standards for healthcare institutions were established due to wide variability in care and outcomes for hip fracture patients. These standards, developed based on numerous international large-scale studies and guidelines [9–12], include early mobilization post-surgery, adequate patient and caregiver education, and the opportunity to engage in rehabilitation. More specifically, it has been suggested that active rehabilitation should begin on or before post-operative day 6, if the patient is medically stable [7]. Furthermore, given the high risk of comorbidities for older adults experiencing a hip fracture, an inpatient geriatric rehabilitation program is recommended [2, 7]. Two well-documented, evidence-based international hip fracture guidelines [13] recommend a multidisciplinary and multidimensional team approach which allows for "biomedical, psychosocial and environmental needs" to be addressed [14]. Multiple studies have shown benefits of geriatric rehabilitation using a multidisciplinary approach to improve functional outcomes, reduce mortality, and decrease admission to long-term care facilities [15, 16].

Despite these standards, many older adults who experience a hip fracture encounter barriers to access rehabilitation and gaps in their care transitions from hospital to rehabilitation to home [17]. Therefore, our team developed an evidence-based pathway intervention: PATH FOR timely transfer of geriatric HIP fracture patients from hospital to rehabilitation to home (PATH4HIP) [18]. The goal of PATH4HIP is to help identify, prioritize, and transfer hip fracture patients to geriatric rehabilitation. The purpose of this study was to pilot PATH4HIP with post-operative geriatric hip fracture patients during their transition from hospital to rehabilitation to home. Specific objectives were:

(1) To determine the feasibility and acceptability of the PATH4HIP intervention, and
(2) To evaluate PATH4HIP's preliminary effects on acute and rehabilitation length of stay, functional gains in rehabilitation, and discharge destination.

Methods

Study design and setting

We conducted a mixed methods feasibility study using the RE-AIM framework [19], to evaluate the feasibility, acceptability, and preliminary effects of the pathway. Dimensions of *Reach, Adoption, Implementation, and Maintenance* were assessed to answer objective 1 (feasibility and acceptability of the PATH4HIP intervention), and the dimension of *Effectiveness* was assessed to answer objective 2 (PATH4HIP's preliminary effects). All data sources, methods, and outcome/process measures for each dimension of the RE-AIM framework [19] are detailed in our published protocol [18].

The study took place on the orthopaedic service on two campuses (A and B) of a large academic health science centre and a geriatric rehabilitation service of a complex continuing care organization in Ottawa, Canada. The study period was from January to September 2022. It was

extended from the planned January–July 2022 period because COVID-19 outbreaks prevented patient transfers to geriatric rehabilitation.

Eligibility

Patients were included if they met the following criteria: (1) aged 65 or older with a unilateral hip fracture, (2) anticipated discharge to community, (3) post-operative hemoglobin greater than 70 g per liter, (4) stability of any acute medical issues, and (5) pre-fracture ambulating independently with or without gait aid. Patients were excluded for the following reasons: (1) pathologic fracture or metastatic cancer diagnosis, (2) on dialysis, chemotherapy and/or radiation treatment, (3) living in long-term care prior to their acute care admission, or (4) presence of an acute agitated post-operative delirium.

Description of intervention

PATH4HIP is a theory-based intervention to help identify, prioritize, and facilitate the timely transfer of eligible hip fracture patients to geriatric rehabilitation within 6 days post-surgery. The Theoretical Domains Framework was used to identify implementation barriers and facilitators [17], and these findings were subsequently mapped to behavior change techniques to guide the development of the implementation strategy [20]. The resulting pathway was structured as a four-step process. First, eligible patients are identified: hip fracture patients aged 65 and older who meet specific criteria are approached, and their consent to participate in the intervention is obtained. Second, patients and their families receive education about the rehabilitation process, including its goals and expected outcomes, to encourage active engagement and collaboration. Third, the clinicians assess the readiness for transfer, ensuring that the patient is medically and functionally prepared to move from the acute care setting to geriatric rehabilitation. Finally, once readiness has been established, logistical arrangements are coordinated to support a smooth and timely transfer, minimizing delays and disruptions in care.

Data collection

Data was collected during the three stages of the study (1) pre-implementation, (2) implementation, and (3) post-implementation.

Pre-implementation

To introduce PATH4HIP and receive feedback from the clinicians, we held a series of online multidisciplinary workshops. We invited clinicians on the orthopaedic and geriatric rehabilitation services to attend, and we also disseminated recorded versions of the workshop to clinicians who could not attend during the scheduled times. We also developed patient education materials, including a pamphlet and a short video.

Implementation

All potential hip fracture patients were tracked through a daily census list. Patients who met the inclusion criteria were enrolled in PATH4HIP. A trained research assistant met with a designated staff daily to track eligible patients and their adherence or non-adherence to the steps of the pathway. Reasons for patient exclusion and patient refusals to go to rehabilitation were also documented.

Post-implementation

Prior to discharge from the geriatric rehabilitation service, a designated physician and research team member recruited the patient participants for follow-up semi-structured interviews. The research assistant then followed up with the interested participants to obtain consent and to conduct 30-min audio recorded interviews in person or by video call to gather their opinion on the pathway and to gather specific information on what could be improved to enhance their experience. We also interviewed clinicians involved in the PATH4HIP. Thirty-minute interviews with clinicians were audio-recorded to obtain their feedback on the intervention's feasibility and acceptability and to obtain their suggestions regarding improvements to PATH4HIP.

With the use of local hospital and rehabilitation admission and discharge records, we collected information on all unilateral hip fracture patients during the study period (i.e., age, sex, ethnicity, relationship status, living situation, Elixhauser score, comorbidities, total acute length of stay, post-surgery length of stay, discharge destination, return to the emergency department within 60 days of discharge, readmissions within 30 days of discharge, rehabilitation length of stay, functional gains, and discharge destination post-rehabilitation).

Outcomes

Outcomes were defined using the RE-AIM framework. The *Reach* outcome was defined as the proportion of eligible patients who agreed to participate. The *Implementation* outcome was defined as the proportion transferred to geriatric rehabilitation by post-operative day 6. *Effectiveness* outcomes included rehabilitation length of stay, functional gains, discharge to the community, and 30-day return to the emergency department. The *Adoption* outcome was the proportion of patients completing the pathway, and the *Maintenance* outcome was assessed through intervention acceptability.

Progression criteria

As defined in our study protocol [18], we used a traffic light system: RED (not to proceed), AMBER (proceed with amendments), or GREEN (proceed) to determine whether we could proceed to a larger follow-up study based on the following progression criteria:

Progression criterion #1

The proportion of eligible participants who agree to enroll in the intervention out of the total number of eligible participants. At least 75% of patients that are deemed eligible for PATH4HIP agree to participate.

Progression criterion #2

The proportion of enrolled participants who completed the intervention out of the total number enrolled. At least 75% of the participants are transferred to geriatric rehabilitation by post-operative day 6.

Sample size justification

Based on the feasibility progression criteria described above, the upper boundary of the RED zone was set at 55% and the lower boundary of the GREEN zone at 75%, corresponding to unacceptable and acceptable to proceed to a larger follow-up study, respectively. Using these thresholds, the required sample size to achieve 95% power with a one-sided α of 0.05 was estimated to be approximately $n=64$ [21].

Data analysis

Descriptive statistics were used (mean and standard deviation for normally distributed continuous variables, median and interquartile range for skewed continuous variables, frequency and proportion for categorical variables) to describe sociodemographic and clinical information during the study period. All data analysis was performed using SAS version 9.4. All interviews were transcribed verbatim. Transcripts were coded and themed independently by two reviewers using an iterative approach [22]. Qualitative data analysis software (NVivo, QSR International) was used to manage all the qualitative data.

Results

Reach

We screened a total of 317 patients during the study period (January–September 2022—campus A and May–September 2022—campus B). A total of 152 patients met our inclusion criteria.

Progression criterion #1: of the 152 eligible patients, 77.0% (n = 117) agreed to participate in the PATH4HIP intervention

Thirty-five patients refused to participate. The reasons for refusal included (1) repatriation to small rural hospitals (37.1%, $n=13$), (2) concerns about COVID-19 (8.6%, $n=3$), (3) previous negative experiences (5.7%, $n=2$), and (4) no specific reasons (48.6%, $n=17$). We found a higher proportion of females in the completed pathway group (78.9%) compared to the patients off pathway (59.3%), patient refusal (54.3%) or non-eligible (61.8%) groups. Patients in the completed pathway group had a lower elixhauser score (1.2 ± 3.2) as well as a lower acute care length of stay (8.1 ± 2.0) compared to the other groups. Deaths in hospital were only noted in the non-eligible group (12.7%, $n=21$). A complete description of the patients' characteristics can be found in Table 1.

Preliminary effectiveness

For patients who completed the pathway ($n=90$), the median post-operative acute care length of stay (LOS) was 7 days (IQR 5–8 days), and for the patients off pathway ($n=27$), the median post-op acute care LOS was 17 days (IQR 12–36 days). The mean functional gains in rehabilitation were 26.2, SD ± 11.7, for patients who completed the pathway ($n=90$), and the median rehabilitation LOS in rehabilitation was 27 days (IQR 21–29 days).

The proportion of patients discharged back to the community post-rehabilitation was 88.9% ($n=80$). Only 4.4% ($n=<5$) were transferred back to acute care. The proportion of patients that returned to the emergency department within 30 days of discharge was also low, at 3.3% ($n=<=5$). The overall outcome measures are described in Table 2.

Adoption

Of the eligible patients, 76.9% ($n=90/117$) completed the pathway. A total of 27 patients were deemed off the pathway due to medical complications ($n=22$), a COVID-19 positive result (n = 4), or hesitation about going to geriatric rehabilitation ($n=1$). These patients were later able to access geriatric rehabilitation through the traditional referral process, and 59.3% ($n=16/27$) of the patients were admitted.

Implementation

The PATH4HIP intervention was implemented with minimal protocol variations.

Progression criterion #2: Of those who completed the pathway ($n=90$), 48.9% ($n=44$) were discharged from acute care by post-operative day 6. The reasons for not being discharged by post-operative day 6 were (1) on a

Table 1 Characteristics of hip fracture patients

	Eligible ($n=152$)			Non-eligible ($n=165$)	
	Completed pathway	**Off pathway**	**Patient refusal**	**Non-eligible**	**Total**
	$N=90$	$N=27$	$N=35$	$N=165$	$N=317$
Age					
Mean ± SD	81.8 ± 8.2	81.7 ± 9.1	79.4 ± 9.6	76.1 ± 15.6	78.5 ± 13.0
Median (IQR)	82 (74–88)	83 (74–89)	81 (71–89)	79 (66–87)	81 (71–88)
Sex					
Female	71 (78.9%)	16 (59.3%)	19 (54.3%)	102 (61.8%)	208 (65.6%)
Male	19 (21.1%)	11 (40.7%)	16 (45.7%)	63 (38.2%)	109 (34.4%)
Marital status					
Married/common law	34 (37.8%)	8 (29.6%)	16 (45.7%)	54 (32.7%)	112 (35.3%)
Divorced/legally separated	< = 5 (5.6%)	< = 5 (7.4%)	< = 5 (5.7%)	14 (8.5%)	23 (7.3%)
Single	< = 5 (5.6%)	< = 5 (7.4%)	< = 5 (11.4%)	23 (13.9%)	34 (10.7%)
Widowed	24 (26.7%)	8 (29.6%)	< = 5 (11.4%)	37 (22.4%)	73 (23.0%)
Other	< = 5 (1.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	< = 5 (0.3%)
Unknown	21 (23.3%)	7 (25.9%)	9 (25.7%)	37 (22.4%)	74 (23.3%)
Point of origin					
Care facility	9 (10.0%)	9 (33.3%)	< = 5 (11.4%)	40 (24.2%)	62 (19.6%)
Home	51 (56.7%)	14 (51.9%)	13 (37.1%)	68 (41.2%)	146 (46.1%)
Home (receiving home care)	< = 5 (1.1%)	0 (0.0%)	0 (0.0%)	< = 5 (0.6%)	< = 5 (0.6%)
Emergency department/outpatient	16 (17.8%)	< = 5 (7.4%)	12 (34.3%)	24 (14.5%)	54 (17.0%)
Inpatient facility	7 (7.8%)	< = 5 (7.4%)	< = 5 (8.6%)	19 (11.5%)	31 (9.8%)
Other/unknown	6 (6.7%)	0 (0.0%)	< = 5 (8.6%)	13 (7.9%)	22 (6.9%)
Elixhauser score					
Mean ± SD	1.2 ± 3.2	3.9 ± 4.9	2.3 ± 4.7	4.1 ± 6.4	3.1 ± 5.5
Median (IQR)	0 (0–0)	3 (0–6)	0 (0–3)	0 (0–6)	0 (0–5)
Total acute care Length of stay (LOS)					
Mean ± SD	8.1 ± 2.0	29.4 ± 19.4	15.7 ± 19.8	18.5 ± 16.7	16.2 ± 16.0
Median (IQR)	8 (7–9)	25 (15–38)	9 (6–15)	13 (7–25)	10 (7–20)
Post op acute care Length of stay (LOS)					
Mean ± SD	6.5 ± 1.8	24.6 ± 19.2	12.2 ± 16.2	15.5 ± 16.3	13.3 ± 14.9
Median (IQR)	7 (5–8)	17 (12–26)	7 (4–11)	10 (5–21)	8 (5–15)
Post op acute care length of stay (LOS) group					
Post op acute care days # ≤ 6	44 (48.9%)	0 (0.0%)	12 (34.3%)	51 (30.9%)	107 (33.8%)
Post op acute care days # > = 7	46 (51.1%)	27 (100.0%)	21 (60.0%)	102 (61.8%)	196 (61.8%)
Surgery date missing	0 (0.0%)	0 (0.0%)	< = 5 (5.7%)	12 (7.3%)	14 (4.4%)
Discharge destination following acute care					
Died in facility	0 (0.0%)	0 (0.0%)	0 (0.0%)	21 (12.7%)	21 (6.6%)
Discharged to community with support	0 (0.0%)	< = 5 (7.4%)	< = 5 (14.3%)	24 (14.5%)	31 (9.8%)
Discharged to community without support	0 (0.0%)	< = 5 (3.7%)	7 (20.0%)	16 (9.7%)	24 (7.6%)
Transferred to group/supportive living	0 (0.0%)	< = 5 (7.4%)	< = 5 (11.4%)	21 (12.7%)	27 (8.5%)
Transferred to geriatric rehabilitation or another facility	90 (100.0%)	21 (77.8%)	18 (51.4%)	60 (36.4%)	189 (59.6%)
Transferred to residential care	0 (0.0%)	< = 5 (3.7%)	0 (0.0%)	20 (12.1%)	21 (6.6%)
Unknown	0 (0.0%)	0 (0.0%)	< = 5 (2.9%)	< = 5 (1.8%)	< = 5 (1.3%)

waitlist due to COVID-19 outbreaks in geriatric rehabilitation (50.0%, $n=23$), (2) medically unstable (23.9%, $n=11$), (3) weekend (15.2%, $n=7$), (4) patient hesitation about geriatric rehabilitation (4.4%, $n=2$), (5) unknown (6.5%, $n=3$). If we consider the patients that were ready by post-operative day 6 but had to wait unexpectedly to

Table 2 Post-rehabilitation outcomes for patients who completed the pathway ($n=90$)

Patients	$n=90$
Return to emergency department (30 days post-rehabilitation)	
Yes	< = 5 (3.3%)
No	87 (96.7%)
Readmission to hospital (30 days post-rehabilitation)	
Yes	< = 5 (2.2%)
No	88 (97.8%)
Admission Functional Independence Measure (FIM)	
Mean ± SD	58.7 ± 14.3
Discharge Functional Independence Measure (FIM)	
Mean ± SD	85.6 ± 18.5
Functional gains	
Mean ± SD	26.2 ± 11.7
Rehabilitation length of stay (LOS)	
Mean ± SD	25.7 ± 8.4
Median (IQR)	27 (21–29)
Discharge destination post-rehabilitation	
Community	80 (88.9%)
Chronic continuing care	6 (6.7%)
Acute care	< = 5 (4.4%)

transfer due to COVID-19 outbreaks in geriatric rehabilitation ($n=23$), the proportion of patients that were ready to be transferred by day 6 was 74.4% ($n=67$).

Maintenance

At the end of the PATH4HIP implementation, semi-structured interviews were conducted with patients/caregivers and clinicians. Overall, participants reported that the PATH4HIP intervention was acceptable.

Patients and caregivers

We interviewed ten patients (six females, four males) and three caregivers (two females, one male) about their experiences with PATH4HIP. The two main themes were clear communication and the availability of supports during the transition between hospital and geriatric rehabilitation.

Clear communication during the transition between hospital and geriatric rehabilitation Some participants acknowledged how clear verbal communication was used during the transfer, with staff keeping patients and caregivers up to date and well-prepared for their transition and answering any concerns or questions. Certain participants expressed a preference for written communication and appreciated having the patient education pamphlet.

> *Oh, I was quite happy to read the brochure [...] I can take my time reading it and, no, I just prefer the written word. It sticks better in my mind like that. (Patient 9)*

Although many participants felt the level of communication was adequate, some participants reported feeling overwhelmed with the amount of communication received, and others noted that at times the information received was lacking, conflicting, or confusing. Certain caregivers noted that they did not receive any information.

Availability of supports during the transition between hospital and geriatric rehabilitation Participants reported that they felt care expectations were met, reporting excellent care and overall positive experiences. Many participants shared that they did not have any issues with the transition and that they would recommend the PATH-4HIP pathway to other patients. However, some participants shared that they felt especially confused in the hospital environment, which made it more difficult to understand the information provided.

> *I was in the [...] hospital for two weeks and I hardly remember anything, I was so out of it. (Patient 2)*

Furthermore, a lack of caregiver support was identified as an important barrier, with some patients expressing that they felt emotionally isolated after surgery. Other patients felt well supported by their overall support system, including their caregivers and their clinicians.

Clinicians

We also interviewed clinicians ($n=10$) from the orthopaedic ($n=6$) and geriatric rehabilitation ($n=4$) services. All clinicians explained how they observed multiple benefits of the initiative for both clinicians and patients, and across settings. The main themes were the benefits of PATH4HIP, the use of patient education materials, and the knowledge and understanding of the eligibility criteria.

Benefits of PATH4HIP Almost all clinicians described that the most important benefit of PATH4HIP was the increased speed of transfer for patients from acute care to geriatric rehabilitation. The efficiency of PATH4HIP was described as a crucial aspect of the initiative, leading to improved flow and maximizing capacity in geriatric rehabilitation.

> *It really has helped us to move, which is our goal as well, is to move patients to subacute care and to*

their rehabilitative care as quickly and as smoothly as possible, and I think the change in the length of time that people wait to get to rehab has been positive. (HCP1)

Most clinicians noted that PATH4HIP required increased communication between clinicians leading to better collaboration within and between settings. Having a common goal also helped foster a positive relationship between the acute care and rehabilitation settings. Some described how the clinicians in acute care settings became more comfortable with discussing and encouraging the geriatric rehabilitation program. Some clinicians in the acute care setting described how their level of independence increased through using the pathway as they could confidently identify patients that were candidates for the pathway. In the cases where they did need support in decision making, many clinicians noted how they appreciated being able to contact the designated geriatric rehabilitation physicians to discuss more complex cases. From the perspective of clinicians in geriatric rehabilitation, PATH4HIP allowed their staff to be better aware of the status and degree of knowledge of patients coming into their facility. A clinician summarized the above benefits as follows:

And I think having that constant understanding that we are going to get this group, and this is where they're coming from, this is the sending unit, it helped develop what I think is, you know, a positive relationship between the two programs. We developed an understanding, you know, they were much better at selling our program to their patients because they knew where they were coming and we were also much more aware of what the patients that we were receiving, the information that they had, that type of thing. (HCP9)

Use of patient educational materials Many clinicians found the educational materials helpful in providing patients with knowledge of PATH4HIP in general as well as what they could expect in rehabilitation. They also reported that the education tools helped answer questions that patients or families had about the process. Some described how the pamphlet specifically helped with discussing and educating patients and families on appropriate candidates. Clinicians in acute care noted that it was sometimes difficult to distribute the video to patients on units given the time constraints and the fact that hip fracture patients were on multiple units. One clinician suggested using the video in a different way, potentially as an educational resource that could be recommended for patients and their families to access on their own devices.

Knowledge and understanding of the eligibility criteria Many clinicians found PATH4HIP was easy to follow and easy to use. The PATH4HIP step that was most often discussed by clinicians was the application of the inclusion and exclusion criteria. Some clinicians reported that the criteria provided a clear framework to determine candidates for the pathway.

The inclusion and the exclusion criteria were majority sufficient to be able to aid in figuring who meets and who doesn't meet the criteria and of course there is always some… the one thing that I think is always good to have feedback is there's no one size fits all or one shoe fits all. And so, I think in the later steps if there's ever a consideration to elaborate on the PATH4HIP, then allowing for some variability for unique circumstances to make sure that patients can still access would be helpful. (HCP4)

For future implementation of PATH4HIP, many clinicians believed that no future organizational changes were needed, and that the initiative was running smoothly. Some clinicians suggested that changes such as increased beds in geriatric rehabilitation and therapy 7 days a week in rehabilitation would be beneficial to the future implementation of the program.

Discussion

Our results confirmed the feasibility and acceptability of the pathway, while key rehabilitation outcomes were not negatively affected. This pathway design prioritizes best practices for hip fracture care and collaboration across health care sectors. For patients who completed the pathway ($n=90$), the median post-operative acute care length of stay was 7 days (IQR 5–8 days) compared to the patients off pathway (17 days (IQR 12–36 days), $n=27$).

In our published protocol [18], we had established two criteria to determine the progression to a larger follow-up study. Our first progression criterion was defined as *at least 75.0% of patients that are deemed eligible for PATH-4HIP agree to participate.* In our study, a total of 77.0% agreed to participate in the PATH4HIP intervention. Therefore, based on these results, our recommendation is to proceed (defined as 'green' traffic light).

Our second progression criterion was defined as *at least 75.0% of the participants are transferred to geriatric rehabilitation by post-operative day 6.* A total of 48.9% of patients who completed the pathway were discharged from acute care by post-operative day 6. If we consider the patients that were ready by post-operative day 6 but had to wait unexpectedly to transfer due to COVID-19 outbreaks in geriatric rehabilitation, the proportion of patients that were ready to be transferred

by day 6 increased to 74.4%. Based on these results, our recommendation is to proceed with amendments (defined as 'amber' traffic light). Therefore, a refinement of methods is needed to proceed to a larger trial. We recommend flagging potential eligible patients for the PATH4HIP intervention using the electronic medical record system to ensure that all eligible patients are transferred in a timely manner. We also hope that since we are in the recovery phase of the COVID-19 pandemic that outbreaks and staff shortages will be minimized. That said, a plan to ensure that we have enough dedicated beds in the sub-acute sector is needed to avoid any unnecessary delays.

In our study, earlier transfers to geriatric rehabilitation via PATH4HIP did not increase deaths, transfer back to acute care, or have any negative impacts on rehabilitation LOS, functional gains, or discharge back to the community. Patients' LOS in rehabilitation was unchanged from the usual submitted data from our institution to the National Reporting Systems (NRS). The median rehabilitation LOS was 27 days (IQR 21–29 days), successfully meeting the provincial targets for length of stay. In addition, progress in rehabilitation, measured using the Functional Independence Measure (FIM), showed a gain of one FIM point per day. The mean functional gains in rehabilitation were 26.2, SD ± 11.72. In addition, most patients (88.9%) were discharged back to the community post-rehabilitation, with only 4.4% ($n = < 5$) transferred back to acute care. Similarly, the proportion of patients that returned to the emergency department within 30 days of discharge from rehabilitation was also low, at 3.3% ($n = < = 5$). Overall, these results remained comparable to previously reported outcome data for this population in our institution.

Our intervention aligns with best practice that allows early access to geriatric care with an interdisciplinary team as part of the overall post-operative management of this population [7, 23]. Cognitive impairment is also common in the hip fracture population [7, 9]. While clinicians in rehabilitation noted increased numbers of patients with cognitive impairment being accepted through the pathway, our rehabilitation outcomes demonstrate that they were still able to be discharged to the community with good functional gains. This emphasizes that the geriatric rehabilitation environment mirrors the activities commonly prescribed for non-pharmacologic management of resolving delirium [24].

In other countries, similar studies have found that integrated care pathways for hip fracture patients have shown a decrease in the acute care length of stay whilst achieving the same functional gains in rehabilitation [1, 25–28]. These integrated care pathways for hip patients have successfully improved patient outcomes [1, 25–30] leading to better cost efficiencies [1, 4, 7]. Future research should focus on spreading PATH4HIP to other organizations and regions.

PATH4HIP is a low-cost intervention that uses existing resources to improve the use of surgical beds, while enhancing post-surgery hip fracture care. We encountered pressures during COVID-19 resulting in delays in transfers to rehabilitation, which included outbreaks in rehabilitation and staffing shortages. The COVID-19 pandemic was a concern for many patients, leading to delays and difficulties in convincing patients to transfer to the geriatric rehabilitation facility. Also, some repatriated patients refused geriatric rehabilitation as they wanted to return to their hometown, potentially foregoing timely access to inpatient rehabilitation.

Strengths and limitations

The intervention was developed based on the results of a theory-based barriers and enablers analysis [17] and used the RE-AIM framework [19] to determine its feasibility, acceptability, and preliminary effects. We also included the input of clinicians, patients, and caregivers in the development and implementation of PATH4HIP, and our findings showed that we received strong buy-in from these groups. Given that the study was conducted within a single health system, caution should be exercised when generalizing the findings to other settings.

Conclusion

We have demonstrated that it is feasible and acceptable to transfer hip fracture patients to geriatric rehabilitation on or before post-operative day 6 via a pathway using existing resources. The design of the pathway using a theory-based barriers and enablers analysis has the potential to increase the likelihood of successful spread to other organizations. As pressures climb for surgical beds, this pathway increases the potential for earlier discharge of hip fracture patients. Timely access to geriatric rehabilitation is also recommended, and our study suggests that earlier transfer does not negatively impact rehabilitation outcomes. Further research using controlled study designs is warranted.

Abbreviations

LOS	Length of stay
FIM	Functional Independence Measure
PATH4HIP	PATH FOR timely transfer of geriatric HIP fracture patients from hospital to rehabilitation to home

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CB and AH were major contributors in writing the manuscript. All co-authors (CB, AH, SP, CW, STP, PEB, VFM) were involved in the design, methodology, and analyses. All authors (CB, AH, SP, CW, STP, PEB, VFM) read, edited, and approved the final manuscript.

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Data availability
No additional data are available.

Declarations

Ethics approval and consent to participate
Approval was granted by the Ottawa Health Science Network Research Ethics Board (#20180469-01H), the Bruyère Research Ethics Board (#M16-18–036), and the University of Ottawa Research Ethics Board (#H-08–18-1061). Study participants provided written consent prior to participating in a semi-structured interview session.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

Author details
[1]School of Nursing, Faculty of Health Sciences, University of Ottawa, 200 Lees Ave, Ottawa, ON K1N 6N5, Canada. [2]Ottawa Hospital Research Institute, 501 Smyth Rd, Ottawa, ON K1H 8L6, Canada. [3]Bruyère Research Institute, 43 Bruyère St., Ottawa, ON K1N 5C8, Canada. [4]Bruyere Continuing Care, Ottawa, 43 Bruyère St., Ottawa, ON K1N 5C8, Canada. [5]The Ottawa Hospital, Ottawa, 501 Smyth Rd., Ottawa, ON K1H 8L6, Canada. [6]School of Rehabilitation Sciences, Faculty of Health Sciences, University of Ottawa, 200 Lees Ave, Ottawa, ON K1N 6N5, Canada. [7]Hawkesbury and District General Hospital, 1111 Ghislain St, Hawkesbury, ON K6A 3G5, Canada.

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