

Effectiveness of a Supervised Patient Ambulation Program in Reducing Fall Risk Following Total Joint Arthroplasty

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This work was supported by a grant received from the Research and Education Fund of Scripps Clinic Medical Group.

Dr. Bugbee or an immediate family member serves as a paid consultant to Arthrex, Depuy, A Johnson & Johnson Company, Enovis, JRF Ortho, Icarus medical, Overture, and Smith & Nephew. Dr. Copp is an associate editor for Foot and Ankle International. None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Dr. Kenney, Mr. Shah, Dr. Tabbaa, and Ms. Evans.

Study approval: This study was approved by the Scripps Health Orthopedic Outcomes Program (IRB #13-6297).

JAAOS Glob Res Rev 2025;9: e24.00407

DOI: 10.5435/JAAOSGlobal-D-24-00407

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ABSTRACT

Background: Total hip arthroplasty and total knee arthroplasty rank among the most prevalent orthopaedic procedures performed globally. Early mobilization postarthroplasty reduces complications, shortens length of stay, and optimizes recovery. However, the incidence of falls remains high, leading to complications and increased costs. Ensuring patient safety during mobilization is critical to minimizing fall risks.

Methods: In 2014, our institution created a supervised patient ambulation program called “No One Walks Alone” (NOWA). A retrospective review of patients undergoing total knee arthroplasty or total hip arthroplasty between 2011 and 2017 was conducted. The inclusion criteria spanned the preimplementation group (2011 to 2013) (N = 3069) and the postimplementation group (2015 to 2017) (N = 3947). Patients in the postimplementation group were enrolled in the “No One Walks Alone” supervised ambulation program. Data on patient demographics, procedures, hospital stay, fall rates, and postfall complications were collected. A logistic regression analysis was done to identify fall risk factors, and statistical analyses were used to compare outcomes between the patient groups.

Results: Inpatient fall rates decreased from 2.5 to 1.0 per 1000 inpatient days between the preimplementation and postimplementation groups, respectively. The difference in fall rates between the two periods was statistically significant (P value < 0.002). Fall-related complications were notably reduced in the postimplementation group. In addition, the postimplementation group saw a statistically and clinically notable reduction in average length of stay in the hospital compared with the preimplementation group by 0.75 days (P value < 0.001).

Conclusion: Implementation of a supervised ambulation program was found to markedly reduce fall rates, length of stay, and fall-related complications, demonstrating the importance of proactive interventions to improve patient safety following arthroplasty.

Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are two of the most common orthopaedic procedures performed.¹ The number of patients undergoing THA and TKA is expected to increase significantly as the global population ages.^{2,3} Although arthroplasties are increasingly becoming outpatient procedures, many are still being done in an inpatient or 23-hour short-stay setting.^{4,5} It is well established that early mobilization postoperatively is important for arthroplasty patients, as it has been shown to decrease the incidence of postoperative complications, decrease hospital length of stay, and optimize functional outcomes.⁶⁻⁸

Maintaining patient safety while mobilizing is critical to avoid falls and further complications.⁹ Accidental patient falls are among the most commonly reported incidents in hospitals.¹⁰ Bouldin et al report that the rate of accidental falls in hospitals ranges from 3.3 to 11.5 falls per 1000 patient days. Each year, falls complicate approximately 2% of hospital stays, resulting in an additional total expenditure of 50.0 billion dollars in medical costs toward treating those patients. Complications because of a fall could include dislocation, fracture, soft tissue injury, hematoma, or wound dehiscence.^{11,12} Many of these complications may require a return to the operating room and revisional surgery.^{13,14}

In addition, it is important to recognize that the costs attributed to accidental falls during hospitalization are no longer covered by the Center for Medicare and Medicaid Services, as accidental falls are considered preventable incidents. Therefore, there is a pressing need to implement novel programs and hospital protocols that will help reduce the incidence of inpatient falls. This will not only improve patient safety but also reduce healthcare costs.

Recently, numerous hospital systems have been working to implement programs that identify patients who are at a higher risk for falls so that the appropriate care and precautions can be taken to ensure patient safety.⁹ These measures include physical therapy, oversight during mobilization, durable medical equipment, bed alarms, safety equipment such as straps and bands, and patient and staff fall education programs.¹⁵⁻¹⁷ Studies have also debated the efficacy of bed alarms in reducing inpatient falls.¹⁸

Beginning in the year 2014, our institution initiated a supervised patient ambulation initiative termed “No One Walks Alone” (NOWA). Previously, the standard of care regarding patient ambulation allowed independent mobilization after a patient was cleared by a physical

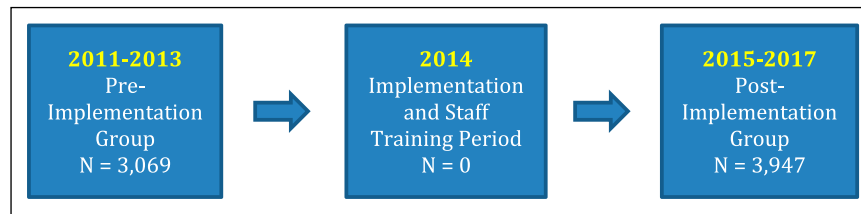
therapist. The NOWA program was a comprehensive initiative to limit the number of inpatient falls for all postsurgical patients by utilizing a multifaceted approach. This program mandates that a nurse, certified nursing assistant (CNA), or physical therapist (PT) accompany all patients during ambulation, requires patients to wear gait belts, and enables bed and chair alarms to go off if a patient ambulates alone. If a patient experiences a fall, they are immediately evaluated by the nursing staff, and details about the fall and any fall-related injuries are documented. Although there could be an increased cost associated with the time the nursing staff would need to walk with these patients, the potential healthcare costs associated with fall-related complications and legal liability issues are far greater.^{19,20}

Although the existing literature describes risk factors and incidence of falls with and without arthroplasty, there are currently no studies that evaluate the efficacy of a novel patient ambulation program on improving postoperative outcomes for hip and knee arthroplasty patients. Therefore, the purpose of this study was to assess the incidence of patient falls and fall-related complications following inpatient TKA or THA, before and after the implementation of a supervised patient ambulation program. We hypothesized that the THA and TKA patients in the postimplementation group would experience less falls, less fall-related complications, and have a reduced length of stay.

Methods

Study Design

A retrospective review was conducted at a single institution of all inpatients who underwent THA or TKA from 2011 to 2017 by one of five orthopaedic surgeons. The inclusion criteria for this study were any postoperative inpatients who underwent hip or knee arthroplasty in 2011 to 2013 (preimplementation group) and 2015 to 2017 (postimplementation group) (Figure 1). Patients in 2014 were excluded to account for staggered staff training and transition into the NOWA program. Patients who refused enrollment in the study were also excluded. Patient demographic data, surgical procedure details, and hospital stay details were collected for all patients in the study. Inpatient length of stay was calculated for both groups. For the patients who experienced a fall, fall rate calculations were performed to determine the incidence of inpatient falls for both the preimplementation and postimplementation patient groups (Figure 2). Details regarding the fall, including time of day, pain medications, postoperative fall complications, and possible treatments

Figure 1

Flowchart depicting study timeline and patient groups. A total of two patient groups were studied over a combined 6-year period. The preimplementation group (N = 3069) included patients undergoing hip and knee arthroplasty from 2011 to 2013 who did not participate in the NOWA program postoperatively. All patients undergoing arthroplasty in 2014 were excluded due to changes in staffing and discrepancies associated with the NOWA program implementation throughout the year. The postimplementation group (N = 3947) consisted of patients undergoing hip and knee arthroplasty from 2015 to 2017 who did participate in the NOWA program during their hospital stay. NOWA = “No One Walks Alone” Ambulation Program.

for the complications, were recorded. Postfall complications were diagnosed and categorized as one of the following: fracture, wound dehiscence, tendon rupture, hematoma, implant loosening, or any problems necessitating a return to the operating room (OR). All patients who sustained a fall were immediately evaluated by the nursing staff, and a standard protocol was initiated. Fall-related injuries were classified as “mild,” “moderate,” or “severe.” “Mild” injuries included any soft-tissue injury that did not cause an open wound or require surgical treatment. “Moderate” injuries included open wounds that required soft-tissue closure or approximation but did not require a trip to the operating room. “Severe” injuries included any injury that required a return to the OR for emergent treatment.

Description of the Fall Prevention Program

All patients admitted to the hospital, and who consented to the study, were enrolled in the supervised patient ambulation program. All enrolled patients had bed alarms on their hospital beds that alerted the nursing staff if the patient began mobilizing without support. Chair alarms were used for patients who preferred sitting in chairs. The NOWA program required that all patients who mobilized would be accompanied by a member of the nursing staff or the physical therapy staff. When a patient did ambulate, a gait belt was used. A description of each intervention associated with the NOWA program is detailed in Table 1.

Statistical Analyses

The number of patients needed to identify a 50% decrease in falls between the control group and study group was determined using a power analysis. The power analysis used the 2% inpatient fall rate and required data collected 8 months before implementing the supervised patient ambulation program. Using the 2% fall rate, $\alpha = 0.05$, and $\beta = 0.80$, it was determined that 2319 patients in each group would be needed.

Independent sample *T*-tests and chi-square tests were used to compare patient demographics, surgical procedure details, and hospital stay details between the preimplementation group and postimplementation group. The incidence of patient falls between the groups was compared using a chi-square test. A subgroup analysis was done between the patients who fell and those who did not to determine any variables that could predict falls. Multivariable models (logistic regression analyses) were used for any variables that were statistically significant in the univariate analyses to identify the risk factors for inpatient falls. All tests were two tailed, and a *P* value of 0.05 was used as the threshold for statistical significance.

Results

A total of 7016 patients across both groups were enrolled in the study, with 3069 patients (1240 hips and 1829 knees) in the preimplementation group (years 2011 to

Figure 2

$$\text{Fall Rate} = \frac{\# \text{ of patient falls}}{\# \text{ of patient days}} \times 1000 = \# \text{ of patient falls per 1000 patient days}$$

Equation used to perform fall rate calculations. The “number of patient falls” was divided by the “# of patient days” in the hospital across the 3-year period for each the pre- and postimplementation groups. This value was then multiplied by 1000 to yield the final fall rate value, which represented the “# of patient falls per 1000 patient days.”

Table 1. No One Walks Alone Program Protocols

Factor or Variable	Description	Purpose	Implementation Steps	Monitoring/Follow-up
Bed alarms	Alarms were placed on hospital beds that serve to notify nursing staff if a patient begins to mobilize without support	Ensure patient safety and prevent unsupervised ambulation	1. Install bed alarms on all patients enrolled in the NOWA program 2. Test alarms to ensure functionality 3. Ensure alarms are activated when patient is in bed	Routine checks of alarm functionality and response times
Chair alarms	Alarms used for patients who prefer sitting in chairs, notifying staff if the patient attempts to stand without assistance	Ensure patient safety in patients who prefer sitting and prevent unsupervised attempts to stand	1. Install chair alarms for patients who choose to sit 2. Test alarms to confirm that they are operational 3. Ensure alarms are activated when patient is in chair	Routine checks of alarm functionality and response times
Staff Accompaniment	Requirement set in place that mandated patients who mobilize must be accompanied by a member of the nursing staff or physical therapy staff	Provide support and ensure safety during patient ambulation	1. Assign nursing or physical therapy staff to accompany patients during times of ambulation 2. Schedule staff shifts to cover all ambulation times 3. Ensure staff are trained in safe mobilization techniques	Ongoing assessment of staff adherence and patient safety
Gait belts	Gait belts were used to assist patients during ambulation, providing them with great support and stability	Enhance patient stability and safety during movement	1. Provide gait belts for all patients participating in ambulation 2. Instruct staff on proper gait belt usage 3. Ensure belts are used correctly during patient ambulation	Monitor proper use of gait belts and adjust as needed
Gait Aid	Based on each patient's unique circumstances, the physician determined whether the use of a certain type of gait aid was necessary during ambulation	Enhance patient stability and safety during movement	1. Collect information on patient fall risk and unique needs 2. Determine whether walkers, canes, or other gait aids are necessary for patient to use during ambulation	Monitor proper use of gait aids as needed on a patient-to-patient basis
Classify all inpatients as high-fall risk patients	Assume all patients are at risk of falling and apply fall prevention strategies	Reduce risk of falls and ensure proper measures are taken to prevent falls	1. Implement fall risk precautions for all patients 2. Apply general safety measures at all times	Regular reassessment of fall risk and safety strategies

(continued)

Table 1. (continued)

Factor or Variable	Description	Purpose	Implementation Steps	Monitoring/Follow-up
Keep within arm's reach	When a patient is out of bed, keep them within an arm's reach to provide immediate assistance if needed	Ensure immediate support and prevent falls	1. Maintain close proximity to patients who are ambulating 2. Ensure staff are aware of proximity protocols	Monitor adherence to proximity guidelines
Ordered activity on care board	Document the prescribed activity and ambulation plan on the patient's care board	Ensure clear communication of activity plans and adherence	1. Update care boards with ordered activities 2. Review and adjust as needed based on patient progress	Regular review of care boards and patient activity plans
Assess ability/ agreement to call for assistance	Evaluate whether patients are able and willing to call for help if needed	Ensure patients can request assistance when necessary	1. Assess each patient's ability to call for assistance 2. Discuss and confirm patient agreement and understanding	Follow-up on patient ability and compliance
Educate patient and family	Educate patients and their families on the importance of using the call light before getting out of bed or chair	Promote patient self-advocacy and safety	1. Provide education to patients and families 2. Emphasize the importance of using the call light for assistance	Periodic reinforcement of education and understanding to patients
Consider alternatives for resistant patients ^a	If a patient resists NOWA practices, consider alternative safety options	Ensure patient safety while respecting patient preferences	1. Explore and implement alternative safety measures 2. Consult with the patient to find acceptable practices	Consistently evaluate and reevaluate the effectiveness of the alternative measures put in place
Partner with MD for injury prevention ^a	Work with the MD to develop unique strategies to prevent patient injury despite resistance to safety practices	Collaborate and use physician insight to implement effective strategies for patient safety	1. Collaborate with the MD to create a tailored safety plan	Ongoing collaboration and plan adjustments

NOWA = "No One Walks Alone" Ambulation Program

^aThe following guidelines should only be implemented if a patient demonstrates resistance or nonadherence to the NOWA protocols.

2013) and 3947 patients (1698 hips and 2249 knees) in the postimplementation group (years 2015 to 2017); 60.6% (4251/7016) of patients were female, whereas 39.4% (2765/7016) were male. The average length of stay in the preimplementation and postimplementation groups was 3 days (SD = 1.1 days) and 2.2 days (SD = 1.1 days), respectively, which was statistically significant (P value < 0.001). Of the patients who had an inpatient fall, 81.3% (26/32) were status post TKA. The average age of the patients who fell was 73.6 years (SD = 8.6 years). Of those who had a fall, 75% (24/32) were female. The average length of inpatient stay of patients

who fell was 3.3 days (SD = 1.5 days) compared with 2.5 days (SD = 1.136 days) for those who did not sustain a fall. This was found to be a statistically significant difference (P value < 0.001). The demographics of patients can be found in Tables 2 and 3.

The average age of patients included during the preimplementation and postimplementation periods were 68.5 years (SD = 10.7 years) and 68.6 years (SD = 10.3 years), respectively. The rate of inpatient falls in the preimplementation group was 2.5 falls per 1000 inpatient days, which was markedly greater than the rate of inpatient falls in the postimplementation group, which

Table 2. Demographics of Preimplementation and Postimplementation Groups

Factor or Variable	Preimplementation (N = 3069)	Postimplementation (N = 3947)	P
Age (yrs)	68.6 ± 10.7	68.6 ± 10.3	0.842
Sex			0.146
Male	1180 (38%)	1585 (40%)	
Female	1889 (62%)	2362 (60%)	
Joint			0.028
Hip	1240 (40%)	1698 (43%)	
Knee	1829 (60%)	2249 (57%)	
Length of stay (d)	3.0 ± 1.1	2.2 ± 1.1	<0.001

Data presented as mean ± SD or N (%)

was one patient fall per 1000 patient days (P value < 0.002). The average postoperative day of falling was postoperative day 1.9 in the preimplementation group and postoperative day 2.1 in the postimplementation group. In the preimplementation group, of the 23 patients who fell, there were 10 “mild,” 4 “moderate,” and 0 “severe” complications. The other nine patients had no injury from their falls. In the postimplementation group, of the nine patients who fell, there was 1 “mild,” 0 “moderate,” and 1 “severe” complication with seven patients sustaining no injuries. Postoperative day of fall was calculated using the date of surgery and date of fall. Patient fall data can be found in Table 4, and descriptions of the injuries and outcomes from each patient’s fall can be found in Table 5.

The patient who had a “severe” complication had undergone left THA. On postoperative day 2, the patient had a syncopal episode while standing and sustained an assisted fall onto both knees bilaterally. The patient was immediately attended to by the nursing staff and was found to be confused, hypotensive, tachycardic and had a low oxygen saturation. A rapid response was called, and the patient was resuscitated.

They were diagnosed with systemic inflammatory response syndrome (SIRS) secondary to pneumonia. The patient had a history of bilateral TKA and reported knee pain after the fall. After further evaluation postfall, the patient was found to have a right distal femur lateral epicondyle fracture with stable TKA components. They were treated with a knee immobilizer and made non-weight-bearing. Examination of the patient’s left knee was consistent with a lateral collateral ligament injury, so they were placed in a hinged knee range of motion brace. Imaging of the left hip was normal. None of these injuries required a return to the operating room. The patient was ultimately discharged to a skilled nursing facility on postoperative day 6.

Discussion

Although other studies have reported variable efficacy of similar measures to prevent inpatient falls, the implementation of the NOWA supervised patient ambulation program markedly decreased inpatient falls in our study. The difference in results could be attributed to the number of different types of interventions included in this

Table 3. Demographics of Patients Who Fell and Patients Who Did Not Fall

Factor or Variable	Patients Who Fell (N = 32)	Patients Who Did Not Fall (N = 6984)	P
Age (yrs)	73.6 ± 8.6	68.6 ± 10.5	0.006
Sex			0.095
Male	8 (25%)	2757 (40%)	
Female	24 (75%)	4227 (60%)	
Joint			0.008
Hip	6 (19%)	2932 (42%)	
Knee	26 (81%)	4052 (58%)	

Data presented as mean ± SD or N (%)

Table 4. Preimplementation vs. Postimplementation Falls

Factor or Variable	Preimplementation (N = 3096)	Postimplementation (N = 3947)	P
No. of falls	23 (0.7%)	9 (0.2%)	0.001
Fall rate ^a	2.5 per 1000	1 per 1000	0.002
Day of fall	POD 1.9	POD 2.1	0.671
Length of stay (d)	3.3	2.5	<0.001
Fall complications	14 (61%)	2 (22%)	<0.001
No injury	9	7	
Mild	10	1	
Moderate	4	0	
Severe	0	1	

POD = postoperative day

^aFall rate (# patient falls per 1000 patient days).

program. The program adopted at our institution included bed alarms, gait belts, and mandatory supervision during ambulation by nursing and physical therapy staff. Many institutions have adopted their own combination or variation of these interventions, such as patient and family education, bathroom protocols, intentional rounding, sitters, physical restraints, and nonslip socks. This combination of multiple different mechanisms and systems to prevent falls can explain the notable difference in effectiveness that this study was able to achieve.

Our study shows that the patients who are at the highest risk of sustaining a fall in the hospital post lower extremity arthroplasty are older women status post TKA. It is important for healthcare workers to be aware of these and other nonmodifiable risk factors that put certain populations at higher risk of falling. In addition, previous studies have shown various geriatric syndromes or older age (>65 years), gait disorders, and specific classes of medications that effect cognitive abilities, can increase the patient's risk of falling.^{21,22} Identifying patients with relevant risk factors and taking proactive measures to ensure those patients' safety is an important strategy as well. In addition to our study implementing alarms, gait belts, and supervision during ambulation, other studies have shown different preventive measures that also decrease fall rates. These include decreasing usage of medication that can induce delirium or change cognitive behavior, implementing a system for toileting as 40% of falls occur in the bathroom, encouraging early mobilization to prevent general health deterioration or weakness, and ensuring that their physical environment is free of obstacles that they could trip over.²³ In addition, other studies showed purposeful rounding, and implementing patient education con-

tributed to decreasing hospital falls.²⁴ Our study could enhance its multimodality system in the future by adding these evidence based interventions to the original NOWA program to possibly show a further decrease in hospital fall rates and an increase in patient safety.

Most patients who sustained a fall were status post TKA. Peripheral nerve blockade is an important component in pain control and early mobilization after TKA.²⁵ Conflicting studies exist regarding the type of peripheral nerve blockade (femoral versus adductor canal) and fall risk after TKA.^{26,27} One study demonstrated an increase in quadriceps weakness, but no increased incidence in falls in patients receiving femoral nerve blocks.²⁸ All of the patients included in the study received femoral nerve blocks that were single injection nerve blocks as opposed to continuous nerve blocks. Therefore, the type of peripheral blockade can be ruled out as a potential confounding factor.

Sustaining an inpatient fall can have multiple adverse consequences and morbidity for patients. The patient in this study who sustained a severe complication from their fall was in the postimplementation group. The patient had a CNA with them when they experienced their syncopal episode and was assisted by the CNA as they fell to their knees. It was possible that the patient's injuries would have been worse if they were unassisted. Because of the fall, the patient sustained injuries that slowed their rehabilitation, increased their pain, and put them at a higher risk for postoperative complications such as deep vein thrombosis (DVT) and pulmonary embolism (PE). In addition, the patient had an increased length of stay, which was reflective of the greater amount of time needed to thoroughly treat both their general medical complications in addition to orthopaedic injuries from the patient's fall.

Table 5. Circumstances Surrounding the Fall and Outcomes of the Fall: Preimplementation vs. Postimplementation

Patient Group	Fall #	Circumstances Surrounding Fall	Outcomes	Postoperative Day of Fall
Preimplementation	1	Not witnessed: occurred during ambulation. Patient claims they called for help, but no one came. Patient tried to go to the bathroom alone and fell	No injury documented or complications to implant	1
	2	Not witnessed: the bed alarm was not placed properly, and patient was found on the ground	Reported of left knee pain and moderate intervention was required	1
	3	Not witnessed: no bed alarm was in place before fall	No injury documented or complications to implant	3
	4	Not witnessed: while the patient was ambulating the patient fell backward and was assisted to the ground by staff. Patient was wearing a gait belt	Moderate intervention was required, but no documented injury	2
	5	Witnessed: the patient tried to get up from the bed and did not want help but slid slowly to the floor. Team assisted the patient back to bed	Mild, no abrasions or new pain	4
	6	Witnessed: the patient used the restroom and leaned forward to wipe themselves causing them to fall forward, landing on their back and right arm	Mild, no documentation as to its effect on her knee	1
	7	Witnessed: on assisted walk to the bathroom, the patient's leg buckled, and there was a controlled slide to the floor	No injury documented or complications to implant	2
	8	Witnessed: the patient tried to get up to go to the bathroom, tripped, fell to the ground, and crawled on his knees back to the bed	No injury documented or complications to implant	1
	9	Not witnessed: the patient was assisted to the bathroom and once there, requested privacy. The patient then fell off the toilet and had a laceration on her forehead	No injury documented or complications to implant	3
	10	Not witnessed: the patient requested help to get up, but by the time the staff showed up to assist the patient, they found her on the floor	No injury documented or complications to implant	2
	11	Witnessed: took a shower and requested privacy from the CNA, so the CNA left. While gone, the patient slipped and fell	No injury documented or complications to implant	3
	12	Not witnessed: the patient requested assistance to use the bathroom, and while waiting for help, the patient tried to walk around and fell onto his surgical knee	No injury documented or complications to implant	1
	13	Witnessed: the patient tried to go alone to the bathroom, tried to wipe with the "wrong hand," their good knee gave out, and they fell to the floor on their good knee	No injury documented or complications to implant	1

(continued)

Table 5. (continued)

Patient Group	Fall #	Circumstances Surrounding Fall	Outcomes	Postoperative Day of Fall
	14	Not witnessed, the patient went to the bathroom and tried wiping on their own while leaning on their walker. They slowly fell to the floor and broke the leg off the walker	No injury documented or complications to implant	1
	15	Witnessed: patient was being assisted and her legs “just collapse” and she was assisted to floor by anRN.	No injury documented or complications to implant	1
	16	Not witnessed: patient found lying on the floor next to their bed and the bed alarm had been removed in preparation to move her to a different facility	No injury documented or complications to implant	4
	17	Witnessed: patient ambulating in hallway with PT with gait belt on and the patient’s left knee buckled and they fell backwards. The patient was lowered onto the ground	No injury documented or complications to implant	2
	18	Not witnessed: patient was found on the floor. They were agitated and tried to pull out his foley and intravenous (IV) catheter. There was some blood on their arm	No fracture, but a moderate sized suprapatellar joint effusion of the left knee (knee that was operated on)	0
	19	Not witnessed: the patient was found on the floor, they did not hit their head, but the patient was confused as to what happened	No injury documented or complications to implant	1
	20	Not witnessed: the patient was found on his knees in the bathroom, holding onto the bathroom counter. They did not call before getting up and the bed alarm had not been turned back on since they changed them earlier. Patient does not report hitting his head	No documented injury, but some oozing from the incision site which was cleaned	3
	21	Not witnessed: the patient tried to get up on his own to see if he was capable of it. They fell and staff in the hallway heard the fall and came to assist	No injury documented or complications to implant	2
	22	Not witnessed: patient called for help while sitting on the floor and stated they do not remember how she fell	No injury documented or complications to implant	3
Postimplimentation	23	Not witnessed: the patient was discovered sitting on the floor and claims they just, “slide off the side.”	No injury documented or complications to implant	1
	1	Not witnessed: the patient was reaching down to unhook their SCDs and slipped out of the bed and landed on their bottom	No injury documented or complications to implant	1
	2	Witnessed: weakness was on the nonoperated leg, which was identified when the patient was ambulating to the restroom. When the patient began turning the corner, they lost balance and were assisted to the ground	No injury documented or complications to implant	2

(continued)

Table 5. (continued)

Patient Group	Fall #	Circumstances Surrounding Fall	Outcomes	Postoperative Day of Fall
	3	Not witnessed: patient went to the restroom alone and fell	No injury documented or complications to implant	1
	4	Witnessed: the patient had spilled some water on the bed and told staff she was ok to get up for it to be cleaned. They stood up quickly and the aid got to the patient, but they fell on her buttocks	No injury documented or complications to implant	0
	5	Witnessed: the patient tried to get up from the bed and did not want help but slid slowly to the floor. Team assisted the patient back to bed	Hip remained ok, but patient sustained left knee distal femur fracture from the fall. The knee was immobilized, and the examination was consistent with lateral collateral ligament tear	2
	6	Witnessed: CNA took patient to the restroom while walking back to the bed, the patient claimed both their knees went out. Rapid response was called because the patient became unresponsive to questions. Patient stated that their left knee hurts, there was some swelling, but the skin remained intact	No injury documented or complications to hardware	5
	7	Not witnessed: MD found the patient in the bathroom. They was found to have two skin tears on the left elbow and left wrist	Patient reported of elbow and lower back pain, but no head or hip injury	5
	8	Not witnessed: bed alarm went off, and RNs ran in to find the patient on the floor. Patient claims that they "slid off the bed."	No injury documented or complications to implant	2
	9	Witnessed: The patient was assisted to the bathroom by the CNA, the patient used a walker for assistive device. After toileting, they got up with the walker and stopped at the sink to wash her hands. The CNA stood at the bathroom door close by keeping an eye on them. After the patient washed her hands, they bent over to do her own pericare and tipped off balance sideways, away from the CNA. The walker interfered with the CNA to fully reach the patient, but the patient was able to grab onto the walker and slow their fall and lower themselves to the floor	No injury documented or complications to implant	0

All patient are referred in the past tense using the pronouns they/them/theirs.

CNA = certified nursing assistant, IV = intravenous, PT = physical therapy, RN = registered nurse

Although none of the patients in this study required a return to the OR to treat injuries sustained from an inpatient fall, it remains a realistic possibility. Other studies have shown surgical complications such as long bone fractures and prosthetic dislocations from inpatient falls.¹⁴ Severe complications such as these would increase both the patients' morbidity and financial cost burden significantly.²⁹ It is likely that if the total number

of patients included in this study was increased, there may have been more injuries from falls that required surgical treatment. Nevertheless, our study did show a decrease in fall severity by 64% in lower tier injuries, such as soft-tissue injuries, wound dehiscences, and joint effusions, in comparison to higher tier injuries, such as long bone fractures or head injuries. A previous, larger study implemented a similar program for 2 years and

reported a notable reduction in serious fall-related injuries per 1000 occupied-bed-days by 76.8% ($P < 0.001$).³⁰ Both Fonda et al and our study show a decrease in fall severity with the implementation of a fall prevention program, underscoring the importance and value of integrating these types of programs in hospital systems worldwide.

Additionally, our study showed a notable increase in inpatient length of stay in the group of patients who sustained a fall in the preimplementation group. As insurers and Center for Medicare and Medicaid Services continue to control costs and move toward bundled payment systems, inpatient costs are becoming increasingly important to minimize. This study showed that patients who fell while in the hospital had an increased inpatient length of stay by 0.8 days, which is clinically notable. With average costs of an inpatient stay ranging from \$1000-\$4000 per night, avoiding falls can result in substantial monetary savings.²⁹ Dykes et al³¹ reported that the average total cost of a fall was \$65,521, of which \$35,365 are direct costs incurred by the hospital. Therefore, fall-prevention programs, such as the NOWA supervised patient ambulation program, can result in savings in excess of millions of dollars over the course of several years, which can be channeled toward addressing other pressing healthcare needs for patients.

Conclusion

In conclusion, our study demonstrates that the implementation of the NOWA supervised patient ambulation program markedly reduced inpatient falls following hip and knee arthroplasty. Our initial hypothesis was proven to be correct as the length of stay, number of falls, and fall-related complications were significantly higher in the preimplementation group. This intervention not only enhances patient safety but also has the potential to decrease healthcare costs associated with extended hospital stays due to fall-related complications, further underscoring the program's effectiveness in improving postoperative care outcomes in arthroplasty patients.

Acknowledgments

We would like to acknowledge Julie C. McCauley, Caroline D. Sanchez, and Ann Marie White for their dedication and help with the execution and completion of this study.

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