

Activity Measure for Post-acute Care Mobility Scoring System: Comparison of Nursing and Physical Therapy Evaluation for Primary Hip and Knee Arthroplasty Patients

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ABSTRACT

Background: Optimizing resource utilization after total joint arthroplasty (TJA) has become increasingly vital. The Activity Measure for Post-acute Care (AM-PAC) “6-clicks” scoring system is a validated, physical therapist (PT)-administered metric of patient basic mobility and predicts discharge disposition. This study aimed to determine whether the use of AM-PAC scoring by nurses in the postoperative period could (1) substitute for AM-PAC scoring by therapists and (2) predict 90-day outcomes in TJA patients.

Methods: We retrospectively reviewed all primary TJAs conducted by two surgeons at a single institution from 2019 to 2021. Patients underwent postoperative AM-PAC evaluation by nursing and physical therapy within 24 hours of surgery, and specific timing of nursing and PT scores was determined. Inter-rater reliability between therapy and nursing scores was analyzed. Multiple regression was used to determine the association between AM-PAC scores and readmissions, complications, length of stay, and nonhome discharge.

Results: In total, 1,119 patients were included. Agreement testing between therapy and nursing scores was weak for all six AM-PAC components, with a Spearman correlation of 0.437. Nursing scores were typically conducted earlier than therapist scores (204.0 ± 249.9 minutes versus 523.5 ± 449.4 minutes; $P < 0.001$). Therapy and nursing scores were not notable predictors for 90-day complications or readmissions. However, higher therapy and nursing scores were predictors of less than 2-day hospitalization (odds ratio [OR] 0.63, $P < 0.001$; OR 0.88, $P < 0.001$) and fewer nonhome discharges (OR 0.62, $P < 0.001$; OR 0.84, $P < 0.001$).

Conclusion: Although nursing-driven mobility assessments could potentially improve efficiency of patient discharge and control costs,

nursing AM-PAC scoring did not serve as an appropriate substitute for PT scoring in patients undergoing primary total hip and knee arthroplasty at our institution.

Optimizing resource utilization after total hip arthroplasty (THA) and total knee arthroplasty (TKA) has become increasingly vital amidst the shift toward bundled payment models and the disproportionate financial risk placed on providers.¹⁻⁴ Furthermore, determining appropriate postdischarge disposition after total joint arthroplasty (TJA) is a complex, multifaceted decision with notable clinical and financial implications. The Activity Measure for Post-acute Care (AM-PAC) “6-clicks” mobility scoring system is a validated measure of patient basic mobility in the acute care setting. This metric is conducted by physical therapists (PTs) within 24 hours postoperatively⁵ and has been incorporated in the postoperative evaluation of arthroplasty patients as an accurate and validated measure of determining discharge disposition after hospitalization.⁶⁻⁸ It has also demonstrated high inter-rater reliability among PTs across multiple specialties.^{9,10} Of note, Menendez et al⁷ reported that the AM-PAC scoring system was an effective means to identify patients in need of rehabilitation early in their hospitalization, which in turn facilitated faster discharge to rehabilitation centers and reduced hospital length of stay (LOS). Recently, Hadad et al⁸ demonstrated that AM-PAC scoring was a good-to-excellent predictor of postoperative discharge disposition in THA and TKA patients with a concordance index of 0.836 for THA patients and 0.790 concordance index for TKA patients.

In an attempt to aid in the postoperative functional evaluation of patients before discharge, nursing staff at our institution complete AM-PAC scoring for patients in addition to physical therapy evaluation. However, to the best of our knowledge, the nursing AM-PAC scoring for hip and knee arthroplasty patients has not been validated in the literature. Furthermore, there has been little characterization of the patient factors that contribute to improved AM-PAC performance. Accelerated perioperative care and rehabilitation after THA and TKA has led to a reduction in LOS and associated healthcare costs and an improvement in health-related quality of life.¹¹ In an effort to further reduce costs and improve resource utilization, nursing identification of high-performing patients who may require little to no inpatient physical therapy before discharge could aid in decreasing hospital LOS.

This study aimed to determine whether the use of the AM-PAC scoring system by nursing staff in the postop-

erative period could accurately substitute for physical therapy scoring in primary hip and knee arthroplasty patients. Furthermore, this study aimed to identify factors that led to improved performance on the AM-PAC scoring system and whether AM-PAC scores predict 90-day outcomes.

Methods

This was a retrospective review of all primary hip and knee arthroplasty procedures conducted by two high-volume surgeons at a single academic institution from January 2019 to March 2021 since the AM-PAC scoring system was implemented at our institution. Inclusion criteria consisted of all primary THA and TKA patients who underwent surgery over this period and had postoperative AM-PAC evaluation by nursing staff and PTs within the first 24 hours of surgery. Exclusion criteria consisted of patients without AM-PAC scores by either physical therapy or nursing and patients undergoing revision arthroplasty, hemiarthroplasty, or partial knee arthroplasty.

The nursing and physical therapy AM-PAC basic mobility scores were recorded for all patients in this study. The AM-PAC basic mobility score includes the following six items: difficulty turning over in bed, sitting down and standing up from a chair, moving from lying on back to sitting on the side of the bed, moving to and from a bed to a chair, walking in hospital room, and climbing three to five steps with a railing.^{5,7} Each item is scored on a four-point Likert scale (overall score range: 6 to 24), with lower scores indicating a greater degree of limitation.⁵

Patient demographics including age, sex, body mass index, Charlson Comorbidity Index, smoking status, and operated joint (hip versus knee) were recorded in a prospectively maintained institutional joint registry. Major complications occurring within 90 days were routinely recorded in our institutional database using International Classification of Diseases, Ninth Revision and International Classification of Diseases, 10th Revision codes that were not present on admission. These were categorized into cardiac (acute myocardial infarction and arrhythmias), respiratory (pneumonia and respiratory arrest), neurological (cerebrovascular infarction or hemorrhage), gastrointestinal (bleeding or ischemia), and genitourinary (acute renal failure). Surgical complications

including mechanical complications, venous thromboembolism, and prosthetic joint infection as defined by 2018 International Consensus Meeting criteria were recorded.¹² Total time from surgery to first postoperative PT AM-PAC score and first postoperative nursing AM-PAC score was calculated using electronic medical record time stamps. In addition, hospital LOS, discharge disposition, and readmissions within 90 days were also analyzed. To increase the capture rate for the end points of this study, our institutional nurse navigator database was also queried to identify patients who presented with perioperative complications or were readmitted at a different facility among our affiliated health systems.¹³ Cost savings that could be expected from transferring responsibility for AM-PAC mobility scoring from PTs to nurses were calculated by comparing US Bureau of Labor Statistics data.^{14,15}

Agreement testing between physical therapy and nursing basic mobility scores was conducted to evaluate the interrater reliability. Intraclass correlation coefficients (ICC) of less than 0.5 indicated weak agreement, 0.5 to 0.7 indicated moderate agreement, and greater than 0.7 indicated strong agreement. Spearman correlation was then conducted to further assess the relationship between physical therapy and nursing basic mobility scores. Paired Student *t*-tests were used to compare parameters between hip and knee patients for physical therapy and nursing scores. Linear regression models were used to evaluate the effect of demographics and comorbidities on the basic mobility raw score. Multiple regression was then used to determine the independent association between basic mobility scores (both physical therapy and nursing) and outcome measures, which included readmissions, complications, LOS, and nonhome discharge. A subgroup analysis was conducted by analyzing hip and knee patients separately. All statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS) version 23 (IBM Corporation). Statistical significance was defined as $P < 0.05$.

Results

There were 1,119 patients included in this study, which consisted of 471 males (42.1%) and 648 females (57.9%) (Table 1). The mean age was 67.0 years, and the mean body mass index was 29.7. The overall average LOS was 1.58 days (interquartile range [IQR] 1.36 to 2.54). Overall, 994 patients (88.8%) were discharged home. There were 78 readmissions (6.97%) within the 90-day period, and 47 patients (4.20%) sustained a postoperative complication. The mean physical therapy basic

mobility raw score was 18.0 (IQR 16.0 to 18.0), and the mean nursing basic mobility raw score was 18.0 (IQR 16.0 to 18.0). No significant difference was observed in physical therapy basic mobility raw scores ($P = 0.113$) or nursing basic mobility raw scores ($P = 0.137$) between hips and knees. The mean time from surgery to first PT AM-PAC score was 523.5 ± 449.4 minutes, and the mean time from surgery to first nursing AM-PAC score was 204.0 ± 249.9 minutes ($P < 0.001$). According to the US Bureau of Labor Statistics, the median pay for a registered nurse was \$77,600 per year or \$37.31 per hour in 2021.¹⁴ By contrast, the median pay for a PT was \$95,620 per year or \$45.97 per hour in 2021.¹⁵

When conducting agreement testing, there was weak agreement between nursing and physical therapy basic mobility scores for turning over (ICC 0.471; 95% confidence interval [CI] 0.423 to 0.516), lying to sitting (ICC 0.351; 95% CI 0.294 to 0.405), bed to chair (ICC 0.291; 95% CI 0.231 to 0.348), sit to stand (ICC 0.227; 95% CI 0.158 to 0.292), walking (ICC 0.301; 95% CI 0.232 to 0.366), climbing (ICC 0.402; 95% CI 0.351 to 0.451), and basic mobility raw score (ICC 0.366; 95% CI 0.299 to 0.428) (Table 2). Spearman correlation also revealed a weakly positive relationship with a correlation of 0.437 (Table 3).

Higher age was found to be a predictive factor for both lower nursing ($P = 0.001$) and physical therapy ($P = 0.007$) scores (Table 4). Multivariable logistic regression showed that physical therapy and nursing basic mobility raw scores were not significant predictors of readmissions (physical therapy score, $P = 0.073$, 95% CI 0.85 to 1.01; nursing score, $P = 0.441$, 95% CI 0.90 to 1.05) or postoperative complications (physical therapy score, $P = 0.496$, 95% CI 0.87 to 1.08; nursing score, $P = 0.673$, 95% CI 0.92 to 1.14) (Table 5). By contrast, higher physical therapy and nursing scores were both found to be significant predictors of a hospital LOS of two days or less, with an odds ratio (OR) for physical therapy basic mobility raw score of 0.63 (95% CI 0.57 to 0.68, $P < 0.001$) and an OR for nursing basic mobility raw score of 0.88 (95% CI 0.84 to 0.92, $P < 0.001$). This negative predictive relationship held true when using multiple linear regression with LOS as a continuous dependent variable for physical therapy basic mobility scores (estimate -0.32 , 95% CI -0.36 to 0.29 , $P < 0.001$) and nursing basic mobility scores (estimate -0.15 , 95% CI -0.18 to 0.11 , $P < 0.001$). Moreover, both higher physical therapy and nursing scores were significant predictors of a lower rate of nonhome discharge, with therapy scores having an OR of 0.62 (95% CI 0.56 to 0.67, $P < 0.001$) and

Table 1. Patient Characteristics of the Entire Cohort (n = 1,119)

Variable	N = 1,119
Age (yr)	67.0 [61.0-74.0]
Sex	
Female	648 (57.9%)
Male	471 (42.1%)
BMI (kg/m ²)	29.7 [26.0-34.1]
ASA class	
1	20 (1.91%)
2	427 (40.7%)
3	570 (54.3%)
4	32 (3.05%)
Elixhauser comorbidity index	1.00 [0.00-2.00]
CCI	0.00 [0.00-1.00]
Joint	
Hip	614 (54.9%)
Knee	505 (45.1%)
Surgical time (mins)	83.0 [72.0-96.0]
LOS (d)	1.58 [1.36-2.54]
<2	572 (51.1%)
≥2	547 (48.9%)
Discharge disposition	
Home	1,047 (93.6%)
Skilled nursing facility	49 (4.38%)
Inpatient rehab	21 (1.88%)
Others	2 (0.18%)
Nonhome discharge	72 (6.43%)
90-d readmission	78 (6.97%)
90-d mortality	0 (0%)
90-d complication	47 (4.20%)
PT basic mobility raw score	18.0 [17.0-18.0]
PT basic mobility T-score	41.0 [39.7-41.0]
PT % disability	40.5 [40.5-43.8]
Nursing basic mobility raw score	18.0 [16.0-18.0]
Nursing basic mobility T-score	41.0 [38.3-41.0]
Nursing % disability	40.5 [40.5-47.1]

ASA = American Society Anesthesiology Class, BMI = body mass index, CCI = Charlson Comorbidity Index, LOS = length of stay, PT = physical therapist

nursing scores having an OR of 0.84 (95% CI 0.78 to 0.90, $P < 0.001$). Subgroup analysis of THA and TKA patients yielded similar findings (Supplementary Table 1, <http://links.lww.com/JAAOS/A837>, and

Supplementary Table 2, <http://links.lww.com/JAAOS/A838>).

Discussion

With a pressing need to optimize resource utilization after TJA in a rapidly evolving healthcare reimbursement climate, the AM-PAC “6-clicks” mobility scoring system provides a validated physical therapy metric of patient basic mobility in the acute care setting to identify the most appropriate discharge destination after hospitalization.^{6,7} By facilitating early discharge disposition decisions, the AM-PAC also plays a critical role in reducing LOS and associated medical costs.⁷ This study sought to determine whether the use of the AM-PAC scoring system by nursing staff in the postoperative period could aid in this postoperative disposition decision making. If so, this could potentially lead to earlier disposition decisions even before commencing physical therapy and consequently help lower healthcare costs.

After comparing nursing and physical therapy scores in the same arthroplasty patients at our institution, nursing scores using the AM-PAC scoring system were notable predictors of postoperative disposition but did not seem to serve as an appropriate substitute for PT scoring. There was only a weak agreement between nursing and physical therapy basic mobility scores for all six components of the basic mobility scores and the composite basic mobility raw score. Furthermore, Spearman correlation testing also showed a weak relationship between the scores. Although physical therapy scoring using the AM-PAC system has been validated in the literature,⁵ the results of this study limit the utility of the nursing scoring using the AM-PAC system in the postoperative care of hip and knee arthroplasty patients. Assuming that nursing and therapy scores are interchangeable for these patients could lead to critical discrepancies in the evaluation of postoperative recovery and discharge disposition recommendations. Our inter-rater correlation results for AM-PAC scoring contrast those reported by Hoyer et al,¹⁰ who found a high inter-rater reliability for nursing-reported and therapy-reported AM-PAC scores in postoperative neuroscience patients, with an ICC value of 0.96, although their study was limited by a small sample size of 118 patients. The lack of inter-rater reliability at our institution could be the result of a discrepancy in the training of physical therapy and nursing staff regarding administering the AM-PAC scoring system and timing within the postoperative period when scores are administered. Although all nursing and therapy

Table 2. Agreement Testing Between Components of the Physical Therapist and Nursing Basic Mobility Scores

Variable of Interest	ICC	95% CI	Agreement Interpretation
Turning over in bed	0.471	0.423 to 0.516	Weak agreement
Lying to sitting	0.351	0.294 to 0.405	Weak agreement
Bed to chair	0.291	0.231 to 0.348	Weak agreement
Sit to stand	0.227	0.158 to 0.292	Weak agreement
Walking	0.301	0.232 to 0.366	Weak agreement
Climbing stairs	0.402	0.351 to 0.451	Weak agreement
Basic mobility raw score	0.366	0.299 to 0.428	Weak agreement
Basic mobility T-score	0.326	0.26 to 0.388	Weak agreement
% Disability	0.326	0.26 to 0.388	Weak agreement

CI = confidence interval, ICC = intraclass correlation coefficients

Interpretation of ICC: < 0.5 = weak agreement, 0.5 = moderate agreement, and ≥ 0.7 = strong agreement.

scores were recorded within 24 hours after surgery, different timing within these 24 hours can lead to very different results depending on when patients recover from anesthesia. Nursing scores were evaluated, on average, much earlier than therapist scores (204.0 ± 249.9 minutes versus 523.5 ± 449.4 minutes; $P < 0.001$). This, in part, could be because of a delay in physical therapy evaluation secondary to staffing availability. Additional research is necessary to determine whether nursing and therapist scoring could be more similar if a standardized training program and standardized timing of administration was implemented. We found that 48.9% of the patients at our institution required greater than two-day LOS (Table 1). This, in part, could be not only due to addressing medical comorbidities of some patients but also due to addressing patient's postoperative rehabilitation needs in a timely manner. Determining the appropriate timing in the postoperative period to accurately implement AM-PAC testing after patients have fully recovered from anesthesia is necessary because this could improve overall patient LOS. According to the US Bureau of Labor Statistics, the median pay for a registered nurse was \$77,600 per year or \$37.31 per hour in 2021.¹⁴ By contrast, the median pay for a PT was \$95,620 per year or \$45.97 per hour.¹⁵ Ultimately, accelerating perioperative care and rehabilitation has been demonstrated to reduce overall health costs.¹¹ However,

despite cost benefits, nursing scores, in their current capacity, do not serve as an effective substitute for therapy scores.

It is not surprising that older age was found to be a predictor of lower nursing and therapy scores because the rate of decline in aerobic capacity exponentially increases with each successive age decade and is independent of a patient's physical activity.¹⁶ Concurrently, an age-related decline in muscle mass is also well documented.¹⁷ Both factors could thus account for poorer postoperative physical performance on the AM-PAC score. In the multiple regression analysis, therapy and nursing basic mobility raw scores did not seem to predict readmissions or postoperative complications. These findings echo those of Menendez et al,⁷ who found that the regression model including the AM-PAC score showed poor association with readmissions and did not perform better than a model that only included age, sex, Charlson Comorbidity Index, and procedure type. However, this contrasted the findings of Arnold et al,¹⁸ who noted that lower AM-PAC scores were associated with a higher risk of readmission.

Contrarily, higher physical therapy and nursing scores were both found to be notable predictors of shorter hospital LOS. This negative predictive relationship held true when using a linear regression with LOS as a continuous dependent variable. Moreover, both higher physical therapy and nursing scores were notable

Table 3. Correlations Between the PT and Nursing Basic Mobility Scores

Independent Variable	Dependent Variable	Spearman Correlation	Relationship
PT basic mobility raw score	Nursing basic mobility raw score	0.4371052	Weak positive
PT basic mobility T-score	Nursing basic mobility T-score	0.4380642	Weak positive
PT % disability	Nursing % disability	0.4384058	Weak positive

PT = physical therapist

Table 4. Linear Regression to Identify Patient Factors Predicting Basic Mobility Scores

Predictors	PT Basic Mobility			Nursing Basic Mobility		
	Estimates	95% CI	P Value	Estimates	95% CI	P Value
Age	−0.04	−0.05 to −0.02	<0.001	−0.03	−0.05 to −0.01	0.004
Sex, male	0.35	−0.05 to 0.74	0.088	0.21	−0.22 to 0.64	0.336
BMI	−0.04	−0.07 to −0.01	0.040	0.01	−0.03 to 0.04	0.727
Nonsmoker	0.23	−0.29 to 0.75	0.384	0.21	−0.35 to 0.78	0.455
CCI	−0.13	−1.16 to 0.91	0.809	0.39	−0.73 to 1.51	0.492

BMI = body mass index, CCI = Charlson Comorbidity Index, CI = confidence interval, PT = physical therapist

predictors of fewer nonhome discharges. This is consistent with recent findings by Hadad et al⁸ who found that AM-PAC 6 clicks basic mobility was a good-to-excellent predictor of discharge disposition after primary TJA. Although nursing and therapy scores were both notable predictors of postoperative disposition at our institution, the weak agreement between nursing and therapy scores at our institution argue that nursing scores should not be used alone in the evaluation of patients' postoperative function. Rather, multidisciplinary care involving the surgeon, PT, and nursing staff may provide a more comprehensive assessment of the postoperative mobility status and optimal recovery setting for patients undergoing hip and knee arthroplasty.

This study included a large sample size of patients with ample statistical power to detect differences in our patient population. Furthermore, this study evaluated the utility of the AM-PAC scoring system over multiple years of implementation at our institution. However, this study had several limitations. First, the retrospective nature of this study introduced inherent biases that were difficult to overcome. Although the AM-PAC score was strongly

associated with LOS and discharge disposition, causation cannot be implied, and its predictive value should be validated in prospective studies. Second, the time at which the nurses and PTs recorded the AM-PAC score relative to the time of surgery and postoperative analgesia administration could have confounded the patient-reported mobility assessment. Third, because this study was conducted at a high-volume tertiary hospital with standardized perioperative care pathways, the institution-specific protocols could have limited the generalizability of our findings.

Conclusion

In conclusion, this study found that while nursing AM-PAC scores were notable predictors of postoperative disposition, they did not serve as an appropriate substitute for PT scoring in a large cohort of patients undergoing primary THA and TKA. In the current era of value-based care, nursing-driven mobility assessments may improve efficiency of patient discharge while simultaneously reducing costs, but validating its use by nurses and measures to

Table 5. Multiple Regression Analysis to Determine the Independent Association Between Basic Mobility Scores and Each Outcome

Predictor Variable	Outcome Variable	OR	95% CI	P Value ^a
PT basic mobility	90-d readmission	0.97	0.87 to 1.08	0.566
	90-d complication	1.00	0.87 to 1.17	0.960
	LOS ≥ 2 d	0.63	0.57 to 0.70	<0.001
	Nonhome discharge	0.70	0.62 to 0.79	<0.001
Nursing basic mobility	90-d readmission	1.01	0.92 to 1.13	0.776
	90-d complication	1.06	0.92 to 1.24	0.427
	LOS ≥ 2 d	0.84	0.79 to 0.90	<0.001
	Nonhome discharge	0.88	0.80 to 0.97	0.009

CI = confidence interval; LOS = length of stay, OR = odds ratio, PT = physical therapist

^aAdjusted for age, sex, body mass index, Charlson Comorbidity Index, and smoking status.

improve correlation with physical therapy scoring is necessary.

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