Comparison of Home Health Care Physical Therapy Outcomes Following Total Knee Replacement With and Without Subacute Rehabilitation

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ABSTRACT

Purpose: Few studies have examined the rehabilitation progression of patients managed through home health care physical therapy services following total knee replacement surgery. This study compares the episodes of care and functional outcomes of patients sent directly home to those discharged to a subacute rehabilitation setting prior to home health care. **Methods:** Prospective data were collected from 212 consecutive home health care patients referred for physical therapy following total knee replacement surgery. Data routinely recorded by the physical therapist at each home visit related to ambulatory progression and physical status was used in analysis. **Results:** Patients admitted to the subacute facilities on hospital discharge were older and less likely to have a caregiver in or near the home. Equivalent physical therapy outcomes were seen regardless of hospital discharge disposition, although patients admitted to subacute rehabilitation settings required an additional 12.4 days. Younger patients admitted to subacute rehabilitation settings demonstrated less desirable outcomes at time of initial home visit, although these differences disappeared by time of discharge from home health care. **Conclusions:** Findings suggest that direct discharge home following total knee replacement surgery is a viable option for many patients. The application of evidence to physical therapy practice can promote more informed decision-making and foster the use of best practice in the home health care setting.

Key Words: total knee replacement, home health care, physical function

INTRODUCTION

In the absence of medical complication, patients are often discharged from the hospital within a few days following total knee replacement (TKR) surgery. Hospital discharge planners are routinely required to determine whether home health care (HHC) services or subacute rehabilitation (SAR) in a skilled nursing facility is most appropriate for the delivery of safe and effective post-hospital physical therapy (PT) care. Decisions about the best approach are hampered by lack of consensus about criteria used to accurately assign patients to either HHC or SAR services.[1]

In response to these inconsistencies, the Medicare Payment Advisory Commission has advised the US Congress to compel the Centers for Medicare and Medicaid to develop a common assessment tool for the acute care, SAR, and HHC settings.[2] Such an objective measure would allow for objective scoring to better guide discharge planning, thereby reducing subjective considerations about 'convenience' and 'ease' during planning discussions. Mohamed et al[3] report that patient expectation and knowledge of the rehabilitation process are prominent factors in determining discharge destination. Previous experience of family or friends may influence an individual's decision about the feasibility of going directly home with HHC physical therapy or to a SAR setting to continue their rehabilitation following TKR surgery.

Oldmeadow reports variation in Australian discharge planning procedures in a prospective observational study of 105 consecutive patients undergoing elective TKR surgery.[4] Although 56% of patients achieved a level of functional mobility sufficient for safe return home, only 36% were actually discharged directly home. In a follow-up study, a risk-adjusted predictor tool was used prior to surgery to identify the proper discharge destination.[5] Implementation of this tool resulted in a 30% increase in direct referrals to HHC services.

Some work has been done to address this concern, with physical status outcome expectations established for both the acute care and inpatient rehabilitation settings.[1,4-9] In addition, long-term outcomes (3, 6, and 12 months) for TKR surgery have been documented. Notably absent, however, is consideration of outcomes of HHC PT, which often serves as intermediate rehabilitation between the inpatient and outpatient settings. Postoperative pain in the acute care setting and scar tissue development in the outpatient setting can be prominent barriers to recovery on either end of the rehabilitation continuum.[10-13] The lack of available information concerning outcomes in HHC is a concern given that patients can experience substantial gains in range of motion between episodes of inpatient and outpatient care.

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The paucity of research in HHC PT is attributable to a combination of factors. First, the independent nature of community-based practice presents logistical issues with regard to access to patients and the collection of data. Second, the variability inherent in the construction, layout, and furnishings of patients' homes may hinder both the creation of a controlled environment and the standardization of data collection procedures. Third, the physical resources and funding available for investigations in the HHC sector are limited; research support has traditionally been directed at larger health care organizations in hospital and academic settings. This may change as lengths of hospital stay continue to decrease and more service is provided by noninstitutional, home-based care agencies.

The purpose of this study was to compare the PT outcomes of patients with 2 different discharge disposition scenarios following TKR surgery performed in acute care settings. In the first scenario, patients were discharged from the hospital to SAR, and, on discharge from SAR, referred for HHC physical therapy for follow-up. In the second, patients were discharged directly from the hospital to HHC. The investigation evaluated each patient's impairments and functional status at initial HHC visit, each subsequent visit, and discharge visit.

Two research questions guided the investigation: (1) Does the physical status of patients using SAR following TKR surgery differ at time of the initial HHC visit in comparison to those who are discharged directly to HHC? and (2) Are the physical status outcomes of both patient groups equivalent at time of discharge from HHC?

METHODS

Design

A prospective, longitudinal, descriptive design was used to document changes in physical status for patients recovering from TKR surgery referred to a privately owned HHC agency for physical therapy care in the Greater Rochester, New York area. The project was undertaken as part of the HHC agency's ongoing performance improvement initiatives, which were intended to maximize care delivery outcomes. A PT team (19 physical therapists and 2 physical therapist assistants) were trained to collect data pertaining to subject characteristics and post-hospital discharge physical status. Data collection occurred over a 12-month period between August 2003 and July 2004. This investigation was reviewed and approved for protection of subjects' rights by the region's Academic Health Science Center's institutional review board.

Sample

Subjects were drawn from a convenience sample of 252 consecutive patients receiving treatment by the HHC agency following TKR surgery. Patients were eligible for inclusion if they had undergone a bi-condylar unilateral TKR and accessed HHC services through the investigating agency (n=212). Thirty-four patients in the convenience sample were excluded for one of four reasons: their TKR was unicondylar, bilateral, or a revision of previous TKR (n=23); postoperative restrictions limited participation in PT (n=1); data in their medical record was incomplete (n=7); or hospital readmission was required during the episode of PT care (n=3). Six eligible patients were not included because the physical therapist who provided care had not participated in training sessions.

Physical Status Outcome Measures

Four impairment level outcomes and one functional level outcome were tracked during the study. The outcomes measured were: (1) pain, (2) active knee flexion and extension range of motion, (3) passive knee flexion and extension range of motion, (4) extension lag, and (5) use of assistive device.

A numerical rating scale was used to assess current level of pain immediately prior to staff departure from the home. Rating options ranged from 0 (no pain) to 10 (worst possible pain) according to The Verbal Rating Scale.[14]

Knee range of motion values were obtained using a 12-inch goniometer with the patient in the supine position on a bed within his or her home. Norkin and White's recommendations for proper goniometric alignment with bony landmarks were used.[15] The best value from among multiple measurements taken during the session was recorded. Active knee extension range of motion was measured by encouraging the patient to produce contraction of the quadriceps while providing verbal and tactile cueing to press the posterior aspect of the knee into the supporting surface. Passive knee extension range of motion was measured with downward overpressure by the PT team member. Active knee flexion was evaluated by asking patients to perform a heel slide while verbally cueing them to draw their heel towards the buttocks. Overpressure at the maximum range obtained with the heel slide was used to determine the passive knee flexion measure.

Extension lag, an indirect measure of strength, was standardized by placing a 3 pound coffee can beneath the popliteal fossa and asking the patient to extend his or her knee and hold the position at maximum level of active extension.

The PT team member recorded the least dependent assistive device used to safely ambulate on level indoor surfaces. A descending hierarchy of dependence upon assistive device was established prior to the study to measure ambulatory progression. The hierarchy included: standard walker, rolling walker, crutch(es), quad or straight cane, and no device required.

Procedures

The PT team was trained in the physical status outcome measures and proper recording methods required for the study to insure inter-rater reliability. A written protocol for consistent measurement was established and each team member rehearsed procedures prior to the initiation of data collection. To protect the privacy of medical records, a single team member was responsible for data entry and management; this strategy limited unnecessary access to privileged health information and facilitated data quality monitoring

activities. Individual subject records or data files were not accessible to the investigator responsible for analysis.

Data collection was initiated at the point of referral to the HHC agency by the HHC admission coordinator stationed in the hospital or SAR facility. Demographic information collected at time of enrollment was used for the description of sample characteristics.

A community health nurse completed the initial HHC admission assessment for patients requiring staple removal, wound care, instruction about medications, or medical observation. Otherwise, a physical therapist conducted the admission assessment, provided treatment, and initiated the data collection process. The initial PT visit occurred within 24 to 48 hours of discharge from the hospital or SAR facility. The initial visit frequency ranged from 3 to 5 visits per week and tapered according to patient progress with range of motion, strength, and functional mobility. Home visits decreased to as little as one visit per week prior to discharge from HHC services. Patients were discharged from HHC PT when the referring surgeon ordered progression to outpatient services, the patient was no longer considered to be homebound, or all PT goals were achieved.

DATA ANALYSIS

Initial data analysis procedures included an assessment of outliers and an evaluation of homogeneity of variance of scores across the sample. Chi square analysis was used for categorical (nominal) data, while two-factor (discharge group; time) multivariate analyses of variance (MANOVA) were used to compare interval level PT outcomes for SAR versus direct-to-home groups. Because age and presence of caregiver in home were different for groups, interaction (interrelation) effects also were examined for group (2 levels; direct to home, to SAR), age (3 levels; <60; 61-70; >70), and presence of caregiver in the home (2 levels; present/absent). A caregiver was defined as an individual who was both readily available and physically capable of providing necessary assistance. The MANOVA procedure was selected because it accounts for the interrelationships among outcome variables; separate ANOVAs do not.[16] Post hoc comparisons, using the most conservative method available to detect differences in sample sizes within youngest and oldest age groups (Scheffe), were conducted for significant findings. The significance level for all tests was set at .05, with data analysis performed using SPSS version 12.[17]

Table 1. Demographic Characteristics of Subjects

Sample Characteristics		Route to Home Health Care Services		Total
		Acute Care directly to Home Health Care (N= 74)	Subacute Rehab To Home Health Care (N=138)	(N= 212)
Gender	Male	26 (35.1%)	40 (28.9%)	66 (31.1%)
	Female	48 (64.9%)	98 (71.1%)	146 (68.9%)
Ethnicity	Caucasian	69 (93.2%)	127 (92.0%)	196 (92.5%)
	African American	5 (6.8%)	10 (7.3%)	15 (7.1%)
	Hispanic /other	0 (0%)	1 (0.7%)	1 (0.4%)
Age	<60	25 (33.8%)	15 (10.9%)	40 (18.9%)
	60-80	44 (59.4%)	99 (71.7%)	143 (67.4%)
	>81	5 (6.8%)	24 (17.4%)	29 (13.7%)
Caregiver Residing in or Near Home		68 (91.9%)	90 (65.2%)	158 (74.5%)
Type of Insurance	Medicare/Medicaid	21 (28.4%)	64 (46.4%)	85 (40.1%)
	HMO	38 (51.3%)	61 (44.2%)	99 (46.7%)
	Private	8 (10.8%)	5 (3.6%)	13 (6.1%)
	Worker's Comp	2 (2.7%)	4 (2.9%)	6 (2.8%)
	Other	5 (6.8%)	4 (2.9%)	9 (4.3%)

RESULTS

Thirty-five percent of subjects in this observational study were discharged directly to home; 65% experienced an interim stay in SAR. The average length of stay in the acute care setting was 4.4 days (SD ± 1.11), regardless of discharge disposition. The average length of stay in the SAR setting was 8.9 days. Patients discharged to a SAR facility were significantly older (M = 72.7 ± 9.2 years) than those discharged directly home (M = 64.9 ± 10.6 years; p = < .0001). They also were less likely to have a caregiver residing in or near the home (X^2=17.3, p < .0001). Sixty-five percent of patients in the SAR group had access to a caregiver compared to 92% in the direct-to-home group. No differences were seen for gender, ethnicity, or insurance coverage. The demographic characteristics of the sample are summarized in Table 1.

Research Question One:

Does the physical status of patients utilizing SAR following TKR surgery differ at time of initial HHC visit in comparison to those who are discharged directly to HHC?

The SAR group was more advanced in 4 parameters (active knee flexion, passive knee flexion, extension lag, and assistive device [X^2=8.43, p=.04]) at time of the initial HHC visit. All other measures were comparable (see Table 2). Because of the possibility that age and caregiver presence in the home may have contributed to the differences between groups, these factors were examined for impact on initial visit outcome. The presence of caregiver had no effect.

In the SAR group, patients older than 71 years had significantly higher active knee flexion scores than patients less than 60 years old (F=7.9; df=2; p < .0001) at time of first home visit. Passive knee flexion scores also were significantly higher for the oldest group of patients admitted to SAR (F = 6.4; df = 2; p = .002). In addition, the oldest group of patients had significantly lower post-procedure pain scores than the youngest group (F = 4.6; df = 2; p = .01). An interaction effect was seen between discharge group and age for active knee flexion (F = 4.5; df = 2; p = .01), in which younger patients who were admitted to SAR prior to home care actually had lower measures at the initial home health care assessment. These less desirable measures were evident for all indicators, although the differences for the remaining indicators did not reach significance in post hoc testing. No differences were seen according to age group in any of the initial visit indicators for patients admitted directly home. This interaction suggests that admission to SAR had a crossover effect for older and younger patients admitted to SARs, with the youngest patients being less further progressed as a result of admission to SAR and oldest patients (>71 years) achiev-

Table 2. Comparison of Physical Therapy Outcomes According to Group & Visit

Outcome Measure	Visit	Group		ANOVA Results		
		Direct to Home Health Care Mean ± SD	Subacute Rehab to Home Health Care Mean ± SD	Group F (p)	Visit F (p)	Interaction F (p)
Active Knee Flexion (Degrees)	**Initial**	72.8±13.1	78.8±14.4	8.7 (.003)	284.3 (<.0001)	1.4 (.23)
	Final	99.1±15.9	101.7±12.8			
Passive Knee Flexion (Degrees)	**Initial**	79.2±12.2	84.7±13.3	8.5 (.004)	265.9 (<.0001)	1.1 (.18)
	Final	103.2±15.9	105.8±12.2			
Active Knee Extension (Degrees)	**Initial**	11.3±8.0	10.7±6.5	.16 (.69)	90.5 (<.0001)	.35 (.56)
	Final	4.9±4.9	5.1±4.7			
Passive Knee Extension (Degrees)	**Initial**	7.6±5.9	3.4±4.7	.49 (.48)	72.3 (<.0001)	.15 (.70)
	Final	7.5±5.5	2.9±3.8			
Extension Lag (Degrees)	**Initial**	24.3±17.2	19.1±8.8	8.1 (.005)	141.5 (<.0001)	4.4 (.04)
	Final	9.6±7.4	8.8±6.5			
Post Treatment Pain (Rating on 0-10 scale)	**Initial**	3.8±2.4	3.7±2.4	.34 (.09)	91.3 (<.0001)	.19 (.66)
	Final	1.7±2.1	1.5±1.9			

ing better advantage. For each of the PT outcome variables, patients in the middle age group had neither an advantage nor a disadvantage from admission to SAR prior to home.

Research Question Two:
Are the physical status outcomes of both patient groups equivalent at time of discharge from HHC?

At the time of discharge from HHC PT, all outcome measures were equivalent. The primary weight bearing status was weight bearing as tolerated regardless of discharge disposition. Most patients used a straight cane, quad cane, or no assistance indoors (78% for direct-to-home group versus 84% for the SAR group). Ambulatory status upon both the initial and discharge visit is reported in Table 3.

There were differences between groups in the time required to achieve PT outcomes; those discharged directly home from the hospital finished HHC services an average of 26.5 ± 7.8 days after the TKR surgical procedure. Those with an interim SAR stay finished HHC services an average of 38.9 ± 13.8 days following surgery. The difference in time to HHC PT service discharge (12.4 days) is statistically significant ($p < .001$) and clinically meaningful in terms of time efficiency to attain desired outcomes. Despite the difference in total time required to achieve desired postsurgical physical status outcomes, the average number of HHC visits (8.6 for direct to home and 9.2 for SAR) were equivalent ($p = .210$).

Physical therapy outcomes for all patients improved significantly over time (see Table 2). In addition, an interaction effect was seen for extension lag, with patients admitted directly to home showing greater gains between the initial and final HHC visits.

DISCUSSION

The team members involved in this project were interested in exploring a specific aspect of clinical practice to assure the care provided to HHC patients was both effective and efficient. In keeping with common performance improvement practices, information routinely collected as part of the normal function of PT visit processes was recorded. As a result, initial differences between groups may weaken the comparison of outcomes and is a potential limitation of the study.

The objective measures obtained by the PT team at each HHC visit allowed for comparison of patients discharged directly home to those admitted to an interim SAR stay following hospital discharge. Because the SAR group received an average of 8.9 additional days of physical rehabilitation in an SAR setting, further progression of each of the physical outcome measures was expected at the initial HHC visit. Initial positive differences were seen in active knee flexion, passive knee flexion, extension lag, and assistive device, but not in active or passive knee extension or post-treatment pain. There was no difference between groups in any physical status outcomes at the time of HHC discharge.

The differences at initial home visit between oldest and youngest patients suggests that younger patients admitted to SAR prior to home care may have more intensive needs at time of hospital discharge. These more extensive needs may have prolonged their recovery period and contrary to usual expectations, placed them behind both midrange and older patients discharged to SAR and then to home. Because PT outcome measures were not assessed at time of discharge from hospital, the meaning of this difference is unknown. This is an area that warrants further investigation to determine whether a differ-

Table 3. Ambulatory Status Indicators Upon Initial and Discharge Visits For Home Health Care Physical Therapy

Ambulatory Status Indicators		INITIAL VISIT			DISCHARGE VISIT		
		Home Health Care Direct (N=74)	Subacute Rehab To Home Health Care (N=138)	Total (N=212)	Home Health Care Direct (N=74)	Subacute Rehab To Home Health Care (N=138)	Total (N=212)
Weight Bearing Status	WBAT	69 (93.2%)	129 (93.5%)	198 (93.4%)	73 (98.6%)	135 (97.8%)	208 (98.1%)
	PWB	5 (6.8%)	9 (6.5%)	14 (6.6%)	1 (1.4%)	3 (2.2%)	4 (1.9%)
Ambulatory Device Indoors	Standard Walker	67 (90.5%)	104 (75.4%)	171 (80.7%)	12 (16.2%)	13 (9.4%)	25 (11.8%)
	Rolling Walker	6 (8.1%)	25 (18.1%)	31 (14.6%)	0 (0%)	7 (5.1%)	7 (3.3%)
	Crutch(es)	1 (1.4%)	2 (1.4%)	3 (1.4%)	4 (5.4%)	2 (1.5%)	6 (2.8%)
	Quad/ Straight Cane	0 (0%)	7 (5.1%)	7 (3.3%)	50 (67.6%)	104 (75.3%)	154 (72.7%)
	None	0 (0%)	0 (0%)	0 (0%)	8 (10.8%)	12 (8.7%)	20 (9.4%)

ence in early outcomes can be achieved for younger patients with intensive PT need admitted directly home versus those receiving intermediate rehabilitation along the way.

There is some evidence that HHC services may be a more cost-effective and desirable discharge destination for patients and caregivers, as compared to an interim stay in SAR.[3,18-21] The multistage utilization of services (which begins with acute care followed by SAR, HHC, and outpatient services) is not uncommon, however, suggesting the potentially preferred, and more cost-efficient processes, are not as frequently used as an option.

Although the patients with an interim stay in SAR in this study were less likely to have a capable caregiver residing in or near the home, 90 of the 138 patients (65.2%) sent to SAR had a caregiver available to assist with postdischarge care. This suggests that some of those who received interim care in SAR might have safely been discharged directly home from the acute care setting.

Despite the frequent use of interim SAR for patients in this study, the number of HHC PT visits was comparable for both patient groups. This finding is consistent with a study reported by Kelly and Ackerman in which a sample of 96 patients scheduled to receive a unilateral hip or knee replacement was asked to self-select their desired postacute setting.[9] No between group differences were seen in the number of HHC visits provided (8.2 and 7.7 visits for HHC and SAR, respectively). In addition, the self-evaluation questionnaire used to evaluate pain perception, ambulation, and daily functional activities, produced equivalent results for both groups at 1 and 3 months following surgery. Because comparable outcomes may be achieved in a similar number of HHC visits, cost/benefit analysis of an interim SAR stay may be useful for determining true impact.

Performance Improvement

Following completion of data collection, analysis, and discussion with care practitioners in the local community, the investigating agency used the results to shape a revision of care delivery protocols for purposes of quality improvement. On average, patients followed by the investigating HHC agency require 4.4 days in the hospital and 8.9 days in interim SAR. In each of these two settings combined, patients receive either daily or twice-daily PT care for an average of 13.3 days. As a result, the HHC PT visit frequency was increased from its previous standard of 2 to 3 days per week and the HHC PT initial assessment was accelerated to occur within 24 hours of acute care discharge. Patients discharged directly to home from the acute care setting now receive 5 sessions of PT per week for the first 14 postoperative days. To date, all insurance providers have approved of this frequency protocol change.

To further ensure quality outcomes through early HHC services, the PT team has developed a care delivery pathway designed to promote consistency of intervention. The pathway includes time schedules to initiate advanced treatment interventions such as passive range of motion, patellar mobilization, surgical scar massage, progressive resistive exercises, and closed kinetic chain activities. In addition, it addresses uniformity with cryotherapy education, activity restriction, and exercise frequency. This pathway supports the recommendations of Mohammed et al, who identified the need for this type of standardization following a survey of 43 HHC agencies in Ontario, Canada.[22]

Based on findings of Oldmeadow et al,[5] the investigating agency expected the front-loading of visits and utilization of a care delivery pathway to provide patients an accelerated ability to access the community. Since initiation of this enhanced frequency protocol, a number of patients are able to access outpatient services earlier in their rehabilitation recovery process. As a result, the least costly rehabilitation setting is being used in a more timely manner to meet postsurgical rehabilitation needs.

Study Limitations

Several limitations to this performance improvement study must be acknowledged. First, the sample was drawn from one HHC agency and subjects could not be randomly assigned to SAR services or directly to HHC. Therefore, the comparability of the groups cannot be assured. Although statistical procedures were used to assess initial differences between groups, no comprehensive health status assessment was used to confirm group equivalency. The study also relied on existing data collected as part of the PT team's home visitation practices, which introduced measurement bias and did not include measures cited in contemporary literature related to postsurgical function such as the Western Ontario and McMaster Universities Osteoarthritis Index and SF-36.[23,24]

Additional research is needed in the area of HHC PT following TKR surgery to replicate and expand the findings of this investigation. As a first step, a randomized clinical trial with a larger sample from multiple care settings could be conducted to better determine cause and effect. Also, the collection of illness severity and comorbidity data are necessary for determining group equivalency. Lastly, the age difference for discharge to SAR should be evaluated further to determine whether older individuals with available caregivers can be discharged safely to home and whether younger patients sent to SARs have greater needs in the immediate posthospital discharge period. This additional information about the effectiveness of direct utilization of HHC PT following TKR surgery would provide additional evidence necessary to evaluate the benefits of PT services in the home.

CONCLUSIONS

To our knowledge, this performance improvement study is among the first to evaluate the patient's physical status at initial HHC visit, each subsequent visit, and HHC discharge visit following TKR surgery. The objective measures obtained at each visit allowed for longitudinal comparisons of patients discharged directly home and those receiving SAR following TKR surgery. The findings of this pilot investigation suggest

equivalent physical status outcomes for patients recovering from TKR surgery as measured at time of HHC discharge.

Professional competence, timeliness, and proper care planning are all imperative to the success of HHC PT following TKR surgery. The surgeon, discharge planner, and most importantly the patient, must have confidence that effective care will be provided in the home if they elect direct-to-home discharge over interim rehabilitation in a SAR facility. By establishing much-needed evidence in the HHC setting, physical therapists can improve care planning standards and advance clinical outcomes.

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