ORIGINAL ARTICLE

Joint Replacement Rehabilitation Outcomes on Discharge From Skilled Nursing Facilities and Inpatient Rehabilitation Facilities

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ABSTRACT. DeJong G, Horn SD, Smout RJ, Tian W, Putman K, Gassaway J. Joint replacement rehabilitation outcomes on discharge from skilled nursing facilities and inpatient rehabilitation facilities. Arch Phys Med Rehabil 2009;90: 1284-96.

Objective: To compare functional outcomes at discharge across postacute settings.

Design: Prospective observational cohort study.

Setting: Eleven inpatient rehabilitation facilities (IRFs), 8 freestanding skilled nursing facilities (SNFs), and 1 hospital-based SNF from across the United States.

Participants: Consecutively enrolled patients (N=2152): patients with knee replacement (n=1401) and patients with hip replacement (n=751).

Interventions: None; examination of existing practice patterns.

Main Outcome Measure: FIM discharge motor score.

Results: Freestanding SNF patients entered with higher motor FIM scores and left with higher scores than did IRF patients. IRF patients, however, achieved larger motor FIM gains and achieved them in a shorter time. In multivariate models controlling for patient differences and onset days, IRFs were associated with better discharge motor outcomes, but the overall setting effect was not large. The largest motor FIM differences were between medium-volume IRFs and low-volume freestanding SNFs: 4.6 motor FIM points for patients with knee replacement and 7.3 motor FIM points for patients with hip replacement. Other differences between settings were much smaller. Multivariate models explained between a third and a half of the variance in outcome.

Conclusions: As a group, IRFs had better motor FIM outcomes than did SNFs, but the size of the IRF advantage was not large. Other important facility and practice characteristics also were associated with discharge outcomes after joint replacement rehabilitation. Earlier and more intensive rehabilitation was associated with better outcomes. The volume of joint replacement patients seen by a facility also plays a part: medium-volume facilities among both SNFs and IRFs had better outcomes.

Key Words: Arthroplasty, replacement, hip; Arthroplasty, replacement, knee; Rehabilitation; Skilled nursing facilities.

IN THE YEAR 2005, a total of 735,064 Americans obtained a total hip or total knee replacement. Of these, 562,300 (76.5%) received some type of postacute care. In fact, joint replacement is the most frequent condition leading to postacute admission in an SNF or an IRF.[1,2] These 2 rehabilitation settings are sometimes seen as potential substitutes for one another, with SNFs providing less intensive rehabilitation services over a longer LOS and IRFs providing more intensive services over a shorter LOS.[3]

Where patients with a hip or knee replacement should obtain their rehabilitation remains a vexing issue in American postacute care. Little is known about the relative outcomes of patients with joint replacement who go to SNFs or IRFs, in part because these 2 venues use different patient assessment tools to compare outcomes.[4] The issue became more contentious after Medicare's 75% rule (now 60% rule) that significantly limited the types of patients with joint replacement who could be admitted to an IRF and still allow an IRF to qualify as an IRF for Medicare payment purposes.[5-7] Implicit in the Medicare ruling was the assumption that patients with joint replacement could be served less expensively in SNFs and achieve roughly similar outcomes.

While the matter of SNF-level versus IRF-level rehabilitation care has been an enduring one in the United States, studies in other

List of Abbreviations

BMI	body mass index
CMG	case-mix group
CMS	Centers for Medicare and Medicaid Services
CSI	Comprehensive Severity Index
IRF	inpatient rehabilitation facility
JOINTS I	Joint Replacement Outcomes in Inpatient Rehabilitation Facilities and Nursing Treatment Sites
JOINTS II	follow up study to Joint Replacement Outcomes in Inpatient Rehabilitation Facilities and Nursing Treatment Sites
LOS	length of stay
OLS	ordinary least squares
OT	occupational therapy
POC	point-of-care
PPS	prospective payment system
PT	physical therapy
SNF	skilled nursing facility

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countries shed limited light on this choice mainly because many countries do not have a tradition of SNF-level care. Australian[8] and Canadian[9] studies in the 1990s compared follow-up outcomes at 12 and 8 months, respectively, among patients with joint replacement who received rehabilitation in a bed-service rehabilitation center and those who went home with or without rehabilitation. Both studies found no significant differences.

In the United States, most studies that have compared postacute outcomes across settings of care have focused on patients with stroke and hip fracture.[10-16] These studies found that patients with stroke who went to IRFs fared better than those who went to SNFs, but found the results for patients with hip fracture mixed, with neither IRFs nor SNFs conferring a clear-cut advantage for patients with hip fracture.

Few studies have focused specifically on outcomes of patients with joint replacement across settings of care. In a 3-city study conducted in the mid-1990s, Kane et al[13] examined follow-up outcomes of patients with hip replacement, but study limitations narrowed the inferences that could be made about home-level, SNF-level, and IRF-level care.

Buntin et al[4] used Medicare claims data from January 2003 through June 2004 to examine outcomes of patients with joint replacement who went home (N=148,558), to IRFs (N=148,874), and to SNFs (N=127,719). They found that IRF patients were admitted with lower levels of function but were discharged at higher levels of function relative to SNF patients. Despite its large numbers, the Buntin[4] study faced 2 major challenges. First, the study's claims data did not allow investigators to control for many of the patient covariates that might affect outcomes. Second, SNFs and IRFs used different patient assessment instruments that were administered at different points in time.

Using a matched-group design (87 IRF and 87 SNF patients) from 1 IRF and 5 SNFs in the same geographic area, Walsh and Herbold[17] reported that IRF patients ambulated longer distances, were discharged home more frequently, were transferred to acute care less frequently, used less home care, and used a walker less frequently. Investigators matched patients on age, sex, type of surgery, and admission ambulation score on the FIM. (When replicating these 4 matching criteria using data from the study reported here, we found some important differences in admission FIM scores between IRF and SNF patients that may not have been addressed in the Walsh and Herbold study).

This article evaluates the outcomes at discharge associated with SNF-level and IRF-level care for patients who have a knee or hip replacement (exclusive of those with hip replacement after hip fracture). The article reports findings from the nationwide multicenter JOINTS I study conducted from 2005 to 2007. This study examined processes of care and discharge outcomes associated with joint replacement rehabilitation. An accompanying article, also based on JOINTS I, examines the types, duration, and intensity of therapy actually received in both SNFs and IRFs, while this article focuses on outcomes at discharge. A follow-up study, the JOINTS II study, examines patient outcomes at follow-up and evaluates use of rehabilitation and health care services in the first several months after discharge from an SNF or an IRF. We report the results of the JOINTS II study in 2 accompanying articles.[18,19]

The central question addressed in this article is which setting of care produces better discharge outcomes for patients with joint replacement after adjusting for patient differences and select facility characteristics. Implicit here is the null hypothesis that there are no differences in outcomes related to setting of postacute care for joint replacement rehabilitation. This question was predicated on the assumption that SNFs and IRFs provide relatively homogeneous sets of services within their respective settings. This assumption, we learned, was not correct mainly because it did not take into account the significant practice differences within settings, particularly among SNFs, including the differences between freestanding and hospital-based SNFs.[3] In this article, we describe how patient outcomes differ at discharge across 3 settings of care: freestanding SNFs, a hospital-based SNF, and IRFs.

METHODS

Overall Study Design

JOINTS I was a prospective observational cohort study. It did not entail a new intervention; instead, it observed the actual processes and practices of care and their associated outcomes. Patient differences were controlled through multivariate analyses that included a large array of patient characteristics, including the patient's level of medical acuity and functional status.

The study design and data collection protocols were approved by both a parent institutional review board and local review boards representing each of the participating facilities. All patients entered the study consecutively from February 2006 through February 2007. Because this was not an intervention study and involved no direct patient contact by study investigators, patient consent was not required, and thus no patient refusals had to be taken into account that might otherwise have altered the relative outcomes observed in the 3 settings of care.

One hallmark of the study was its clinical practice team comprised of local study site directors and front-line clinicians from both SNFs and IRFs who worked together to develop the study's data collection protocols and review study findings. Because SNFs and IRFs sometimes are viewed as competing service delivery systems with different advocacy interests, we created the clinical practice team as a vehicle both to improve study methods and to forge consensus and buy-in across participating facilities.

Study Facilities

Several factors were considered when recruiting facilities for the study. Because the size, scope, and funding of the study did not allow for a national probability sample of facilities, our most important facility selection goal was to achieve geographic diversity. We sought to recruit at least 2 SNFs and 2 IRFs from each of the 4 major census regions. Moreover, we sought a mix of freestanding and acute hospital-based facilities, for-profit and nonprofit facilities, and facilities from both high and low managed-care markets.

Because of the extensive ramp-up activities associated with data collection design and training at each facility, we sought facilities that could bring 200 or more patients into the study and thus reduce facility transaction costs. We had to relax this threshold as recruitment continued among SNFs, which had much lower patient volumes than projected.

Facility participation was entirely voluntary. One participating SNF had significant data quality issues, and another SNF with a handful of patients was unable to compile its data in a timely manner. We excluded both facilities from the final study sample. As we report in DeJong et al,[3] the study's sole hospital-based SNF had practice differences that were materially different from the study's freestanding SNFs. Thus, we present findings for 3 types of facilities: (1) 8 freestanding SNFs, (2) 1 hospital-based SNF, and (3) 11 IRFs. In our multivariate analyses, we considered the hospital-based SNF both as an independent setting and as 1 of several SNFs by combining it with the freestanding SNFs.

Study Group

Patient selection criteria for this study were broad: (1) 21 years or older, (2) admitted after hip or knee replacement of any type (including bilateral replacements and revisions), (3) admitted from any source, and (4) did not have a hip fracture prior to hip replacement. We excluded patients with hip fracture for this analysis mainly because this subcohort presented a different demographic and treatment profile.

Measures and Instruments

Three measures and instruments were used: (1) the CSI, which measures patient acuity at admission; (2) the FIM, which measures patient functional status at admission and discharge; and (3) the study's POC documentation system, which measures processes of care over the course of the patient's stay.

Comprehensive Severity Index. As the study's principal severity adjuster, the CSI provides a comprehensive, disease-specific measure of severity of illness and acuity. It considers over 2200 potential variables that include patient characteristics, medical history, physiologic parameters, laboratory findings, and a myriad of patient signs, symptoms, and physical findings. The CSI score combines a patient's physiologic, functional, and psychosocial complexity into a single overall score based on the extent and interaction of all the patient's various health conditions. CSI is a continuous score with no upper limit.[20-25]

FIM. The FIM, along with CSI, served as an important risk adjuster at admission. FIM consists of 2 subscales: (1) a 13-item motor subscale and (2) a 5-item cognitive subscale.[26,27] Each item uses a 7-point scale. Motor FIM was the study's main outcome variable because it was the portion of FIM that was most aligned with the goals associated with joint replacement rehabilitation. The study used both motor FIM and cognitive FIM to characterize the patient at admission to rehabilitation. Cognitive FIM was not used as an outcome measure because patients with joint replacement rarely present serious cognitive limitations, and cognitive FIM demonstrated significant ceiling effects at discharge. In all instances, we used the unweighted motor and cognitive FIM scores because there is no known Rasch-adjusted FIM scoring system or weights for patients with joint replacement. Additional information about the study's use of FIM can be found in the accompanying article by DeJong et al.[3]

We also used FIM to categorize patients into 6 CMGs used by CMS for IRF payment purposes. We collapsed the 6 CMGs into 3 CMG groupings and labeled them as mild, moderate, or severe as outlined in table 3 of DeJong et al.[3]

Point-of-care documentation instruments. An important feature of the JOINTS study was the collection of all processes of care in order to characterize similarities and differences of care rendered across all 3 settings and how these differences might be taken into account when evaluating outcomes. Because patient records across participating SNFs and IRFs provided an inadequate and nonuniform characterization of rehabilitation care a patient received, we created and tested, with the help of the study's clinical practice team, a standardized POC documentation instrument for each major rehabilitation discipline that could be used across all participating sites.

In this article, we use POC data derived only from physical and occupational therapy POC instruments because these 2 POC instruments were used consistently and uniformly. Moreover, in this article we address only the intensity of therapy as measured by the overall amount of therapy divided by the patient's LOS; we do not address the role of specific therapy activities in facilitating outcomes. Therapy intensity is a defining difference between SNFs and IRFs and thus also serves as a proxy for differences between SNFs and IRFs. We provide a more granular characterization of individual therapy activities across all 3 types of facilities in an accompanying article by DeJong.[3]

Data Collection and Reliability

Facility characteristics. We obtained data on facility characteristics from 2 main sources. First was the provider of service files maintained and updated quarterly by CMS for each Medicare-certified provider. CMS creates the provider of service from the Online Survey and Certification Reporting System to which individual study facilities report key facility characteristics. Second was a 1-page facility characteristics questionnaire sent to each study facility site director to confirm and supplement data obtained from CMS provider of service files. From these 2 sources we obtained data on facility characteristics such as geographic location, profit status, bed size, annual patient volume, occupancy rates, physician and pharmacy services, payer mix, staffing ratios, and presence of beds dedicated to orthopedic or joint replacement rehabilitation patients.

FIM. The FIM was administered at admission and discharge in all 3 settings. Because SNFs do not use FIM routinely as do IRFs, it was essential to make sure that SNFs interpreted and administered the FIM in the same manner as IRFs. To ensure that all sites administered the FIM appropriately and consistently, we engaged IT HealthTrack, a FIM training and follow-up survey organization, to train clinical staff at each study site. SNF clinicians completed a 3-day training session, and all clinicians were required to score 100% on an examination that tested their knowledge of FIM and its uses. While we did not conduct formal reliability checks thereafter, we did evaluate FIM scoring to determine whether there were any anomalous FIM scores, at both the individual and facility level, relative to what else was known about individual patients—for example, age and admission CSI—to determine if corrective action was required.

Point-of-care documentation. Physical and occupational therapists collected POC therapy activity data in 5-minute increments either during the course of therapy or immediately at the conclusion of a therapy session. This documentation was included in the patient chart and was later abstracted during chart abstraction. Altogether, the study collected data on 61,146 PT and OT sessions.

Reliability of POC data was checked internally but not across settings. However, because therapists from all settings participated in POC development and definitions and they participated in therapy-specific conference calls throughout data collection to address questions across all sites, we expect that POC data are as reliable as other variables defined and obtained from existing medical charts.

Chart abstraction. Each study facility designated a chart abstractor who underwent a 3-day off-site training program using charts from the abstractor's own facility. An experienced chart abstractor worked with the facility-designated abstractor in reviewing sample charts until the 2 achieved 95% agreement on all data elements abstracted. Once abstracted, these data were reviewed, edited, and entered into the database by project staff. Reliability was checked periodically throughout data collection and at the end of data collection by randomly selecting charts from each site for reabstracting by project staff. Data abstractors continued to maintain 95% agreement on all data elements abstracted.

Through the chart abstraction process, we obtained data on patient characteristics, patient medical history, comorbidities, living situation, employment status, payers, use of durable medical equipment, use of orthotics and prosthetics, medica-

tions, and a variety of other variables related to patient status and outcome. Through chart abstraction we also obtained all the data needed to determine the patient's severity of illness and acuity as measured by CSI described above in Measures and Instruments.

Data Analysis

We used both descriptive and multivariate analyses to examine facility and patient characteristics and how they relate to outcomes. We took into account important differences within as well as between facility types (freestanding SNF, hospital-based SNF, IRF). One of these differences was annual volume of patients with joint replacement; we subclassified study facilities further by annual volume of patients with joint replacement served—low, medium, high, and very high volume. To determine facility volumes, we chose calendar year 2006 as the reference year because it coincided with the study's data collection period (table 1). (A facility's joint replacement volume should not be confused with its bed size; a small facility, for example, may serve a very high volume of patients with joint replacement because it chooses to specialize in rehabilitation of patients who had a joint replacement.)

We used OLS regression in SAS statistical software[a] to identify variables that were significantly associated with motor FIM outcomes at discharge. We checked for multicollinearity and considered possible interaction terms. We used a stepwise selection process that allowed variables to enter and leave the model and evaluated the relative strength of each variable by examining its F value. We chose the most parsimonious models by allowing only significant variables ($P<.05$) to remain in the model.

Separate OLS regression models were created for patients with knee replacement and patients with hip replacement with discharge motor FIM as the dependent variable. We considered 3 sets of independent variables: (1) patient characteristics (eg, age, sex, level of education, living status, revision [yes/no], bilateral replacement [yes/no], patient acuity as measured by CSI, motor and cognitive FIM scores on admission); (2) facility characteristics (eg, type and volume); and (3) 2 POC variables (eg, onset days or days from surgery to onset of rehabilitation, and intensity of OT and PT measured by total hours of OT and PT divided by LOS).

The 2 POC variables deserve greater elaboration. First, onset days may represent a practice difference between SNFs and IRFs or may be an independent predictor of outcomes and thus needs to be taken into account. Varying number of onset days may be a function of (1) discharge planning and referral practices in acute care, (2) health plan or fiscal intermediary decision-making, (3) efficiency of SNF or IRF admission processes, (4) availability of SNF and IRF beds in a given geographic area, or (5) medical complications that may have prolonged the patient's stay in acute care. Thus, we chose to consider onset days as an independent predictor without attributing its value to any one of these possible explanations. Onset days is part of the baggage that the patient brings to the rehabilitation process and thus could be considered a patient characteristic as well as a process variable.

Second, intensity of therapy is as much a facility characteristic as it is a POC variable mainly because SNFs and IRFs are defined in part by the intensity of care they provide—with SNFs offering a less intense level of therapy and IRFs offering a more intense level of therapy because of the 3-hour rule. In short, therapy intensity, though a continuous variable, also serves as a proxy for setting of care—SNF or IRF.

We report 3 sets of regression models for patients with knee and hip replacement. In model 1, we allowed only patient characteristics and setting to enter, not volume or intensity. In model 2, we also allowed facility characteristics such as intensity and volume to enter. In model 3, we omitted intensity because of its strong association with setting and instead allowed volume-facility combinations—for example, high-volume SNFs or medium-volume IRFs. In running our 3 regressions models, we considered models in which the hospital-based SNF was considered a distinct setting apart from freestanding SNFs and IRFs, another in which the hospital-based SNF was excluded altogether, and another in which the hospital-based SNF was combined with the freestanding SNFs, an all-SNF model.

We also conducted a logistic regression analysis to determine the robustness of our OLS regression findings. To do so, we redefined the patient's FIM gain as a dichotomous outcome variable: whether the patient achieved a FIM gain of 25 or more points (fiftieth percentile gain).

For multivariate analysis we did not consider postdischarge destination (eg, home, institutional setting) because there was very little variation in discharge outcomes except in a few instances as noted in table 4. Lack of variation was expected because a hip or knee replacement is most often an elective procedure, and patients expect to go back to their homes or the living environment from which they came.

Table 1: Facility Volume—Annual Number of Patients With Joint Replacement*

Facility Volume	No. of Patients With Joint Replacement (2006)	No. of Study Facilities		
		Fs-SNF	Hb-SNF	IRF
Low volume	20–45	4	0	0
Medium volume	100–183	3	0	5
High volume	272–347	1	1	4
Very high volume	604–606	0	0	2

Source: JOINTS study.
Abbreviations: Fs-SNF, freestanding SNF; Hb-SNF, hospital-based SNF.
*The table displays the number of patients with joint replacement served by a JOINTS study facility in 2006, not the number of patients with joint replacement in the JOINTS study itself.

RESULTS

Study Facilities

The final study sample included patients from 20 facilities—8 freestanding SNFs, 1 hospital-based SNF, and 11 IRFs. All 11 IRFs were freestanding (table 2). While the study sought a representative balance of freestanding facilities and hospital-based units among study SNFs and IRFs, the vast majority of study facilities were freestanding, in part because hospital-based units did not have the target volumes we sought. About one third of the freestanding SNFs and nearly three fourths of the IRFs were nonprofit facilities, as was the hospital-based SNF, although the hospital-based SNF was staffed by contract therapists from a for-profit company. Thus, the distinction between for-profit and nonprofit was not always a clear one. About one third of study facilities had a dedicated orthopedic or joint replacement rehabilitation unit with designated beds.

While study freestanding SNFs had many more beds than study IRFs on average (180.3 vs 99.1), study IRFs served an average of nearly 300 patients with joint replacement a year, while study freestanding SNFs served an average of about 100 patients a year. Study facilities fell neatly into 1 of 4 facility volume categories as outlined in table 1—low, medium, high, and very high volume. Cut points between these categories were clear and unambiguous.

Table 2: JOINTS Study Facility Characteristics by Type of Facility Compared With All SNFs and IRFs Nationally

Facility Characteristics	JOINTS Study			National*	
	Fs-SNF n=8	Hb-SNF n=1	IRF n=11	SNF n=15,027	IRF n=1219
Size (no. of beds), mean ± SD	180.3±111.5	50.0	99.1±45.1	107.3±64.9	31.5±28.1
Has dedicated orthopedic or joint replacement unit (%)	25.0	Yes	36.4	NA	NA
Nonprofit (%)	37.5	Yes	72.7	28.8	61.8
Freestanding (%)	100.0	No	81.1	92.0	17.9
Hospital-based unit (%)	0.0	Yes	18.9	8.0	82.1
2006 Occupancy rate (%), mean ± SD	90.4±11.1	85.0	90.0±16.8	NA	NA
No. of patients with joint replacement in 2006, mean ± SD	98.8±86.3	315.0	295.2±170.8	NA	163.4
24-Hour onsite physician coverage (%)	37.5	Yes	100.0	NA	100.0
Onsite pharmacist coverage (%)	0.0	Yes	100.0	NA	NA
Geographic region					
Northeast	2	√	2	2722	215
Midwest	4	0	2	4813	334
South	1	0	4	5133	466
West	1	0	3	2349	202
Payer mix†					
Non-HMO Medicare patients (%)	83.9	81.2	70.8	NA	63.4
HMO patients (%)	19.3	14.0	16.0	NA	NA

Source: JOINTS study facility questionnaire and Centers for Medicare and Medicaid Services provider of service file.
Abbreviations: Fs-SNF, freestanding SNF; Hb-SNF, hospital-based SNF; HMO, Health Maintenance Organization; NA, not applicable.
*Includes all SNFs and IRFs nationally. Many SNFs and some IRFs do not serve patients who had a joint replacement. Ideally, one would want to compare study SNFs and IRFs with the subset of facilities that serve patients with joint replacement.
†Payer mix for all patients in study facilities, not just those in JOINTS study. See tables 4 and 5 for the payer mix of patients included in the study.

Though nominally an SNF, the hospital-based SNF was a hospital-based facility that shared therapy staff with a sister IRF in the same hospital and had many features of an IRF such as an average LOS of 8.8 days, ready access to physician and pharmacy coverage, a volume of patients with joint replacement comparable to study IRFs, and similar levels of patient severity. It was similar to a freestanding SNF mainly in therapy intensity (1.8 therapy hours a day). In short, the hospital-based SNF was a hybrid of a freestanding SNF and an IRF (see fig 1 in DeJong et al[3]).

Patient Characteristics

As outlined in table 3, the final study group consisted of 2152 patients, 65.1% of whom had a total knee replacement and the remaining 34.9% of whom had a total hip replacement. Some 62.4% of the entire study group came from IRFs, 25.2% from freestanding SNFs, and the remaining 12.4% from the study's hospital-based SNF.

Freestanding SNFs and IRFs served similar percentages of patients with knee revisions (5.4% and 6.1%, respectively) and hip revisions (15.3% and 16.1%, respectively). However, IRFs served larger percentages of patients with bilateral knee replacements and hip replacements: 18% of IRF patients with knee replacement had a bilateral replacement versus 4% of freestanding SNF patients with knee replacement. Likewise, 3.5% of IRF patients with hip replacement had a bilateral replacement versus 0.5% of freestanding SNF patients with hip replacement. The hospital-based SNF had much lower rates of

Table 3: Numbers of Patients in JOINTS Study Group by Type of Replacement*

Type of Joint Replacement	Fs-SNF		Hb-SNF		IRF		Total	
	n	%	n	%	n	%	n	%
Knee replacement	353	65.0	189	71.1	859	64.0	1401	65.1
Hip replacement	190	35.0	77	28.9	484	36.0	751	34.9
Total	543	100.0	266	100.0	1343	100.0	2152	100.0
Knee replacement								
Unilateral	339	96.0	187	98.9	704	82.0	1230	87.8
Bilateral	14	4.0	2	1.1	155	18.0	171	12.2
Total	353	100.0	189	100.0	859	100.0	1401	100.0
Revision	19	5.4	9	4.8	52	6.1	80	5.7
Hip replacement								
Unilateral	189	99.5	77	100.0	467	96.5	733	97.6
Bilateral	1	0.5	0	0.0	17	3.5	18	2.4
Total	190	100.0	77	100.0	484	100.0	751	100.0
Revision	29	15.3	6	7.8	78	16.1	113	15.1

Source: JOINTS study.
Abbreviations: Fs-SNF, freestanding SNF; Hb-SNF, hospital-based SNF.
*Table 3 does not include the 226 patients in the JOINTS study who had a hip replacement following a hip fracture. Table 3 includes only those in the JOINTS study who had a knee or hip replacement and an LOS of 52 days or less.

Table 4: Characteristics and Outcomes of Patients With Knee Replacements

Characteristic or Outcome	Fs-SNF				Hb-SNF‡	IRF				F or χ^2‖	*P*
	Low Volume (n=45)	Medium Volume (n=187)	High Volume (n=121)	Total (n=353)	High Volume (n=189)	Medium Volume (n=297)	High Volume (n=363)	Very High Volume (n=199)	Total (n=859)		
Demographics											
Age (y)	72.5±8.3	74.8±7.5	69.8±10.2	72.8±8.8	73.1±7.1	70.1±9.9	70.3±10.1	69.5±10.3	70.0±10.1	8.69	<.001
Sex (% female)	80.0	70.6	76.9	74.9	72.0	70.7	76.6	65.8	72.1	10.76‖	.096
Race (% white)	100.0	95.7	39.7	77.3	97.9	90.2	69.4	81.4	79.4	257.34‖	<.001
Lived alone (%)	22.2	39.6	43.0	38.4	36.0	31.7	38.8	25.6	33.3	19.92‖	.003
Payer mix (% non-HMO Medicare)	82.2	81.3	81.8	81.6	79.9	73.4	70.5	79.4	73.6	16.01‖	.014
Health and functional status											
Admission CSI*	16.8±11.7	21.7±11.2	29.6±8.5	23.8±11.3	28.6±7.9	28.5±12.7	31.9±14.9	25.2±11.4	29.2±13.6	23.57	<.001
BMI	31.5±5.8	31.4±6.3	35.5±8.1	32.9±7.2	34.4±7.9	32.6±6.8	33.0±7.7	31.9±6.5	32.6±7.1	6.26	<.001
Admission motor FIM	52.8±12.8	51.1±8.0	48.1±7.6	50.3±8.8	46.4±8.5	42.2±7.5	42.6±8.0	42.1±9.0	42.3±8.0	42.61	<.001
Discharge motor FIM	69.3±12.6	73.4±6.4	69.1±6.5	71.4±7.8	69.8±6.4	69.2±7.0	67.7±7.2	68.3±8.4	68.3±7.5	13.26	<.001
Change in motor FIM	16.5±9.5	22.2±8.1	21.1±6.3	21.1±7.9	23.5±7.6	27.0±7.5	25.1±7.6	26.1±8.3	26.0±7.8	22.36	<.001
Admission cognitive FIM	32.0±5.4	33.6±3.0	34.7±1.6	33.8±3.2	30.3±4.5	29.4±6.0	29.8±4.9	31.9±3.4	30.2±5.1	42.61	<.001
Onset days†	4.8±2.8	4.4±2.0	3.2±2.2	4.0±2.3	3.5±1.6	4.1±3.1	4.0±3.3	3.8±1.8	4.0±3.0	4.35	<.001
CMG (%)											
801–802	80.0	73.3	62.0	70.3	67.2	48.8	47.1	52.8	49.0	77.35‖	<.001
803–804	8.9	20.9	28.9	22.1	23.3	30.6	36.9	36.7	34.7		
805–806	11.1	5.9	9.1	7.7	9.5	20.5	16.0	10.6	16.3		
Comorbidities (%)											
Morbid obesity (BMI ≥40)	8.9	10.2	26.5	15.6	19.6	15.2	14.9	10.1	13.9	24.04‖	<.001
Hypertension	71.1	71.1	81.0	74.5	79.9	76.1	68.9	66.8	70.9	17.32‖	.008
Diabetes	31.1	14.4	28.1	21.3	28.0	24.2	20.4	22.1	22.1	15.72‖	.015
Ischemic heart disease	11.1	15.5	10.7	13.3	21.2	17.9	17.6	9.6	15.8	14.76‖	.022
Tier 1 (most severe)§	0.0	0.0	0.0	0.0	0.0	0.7	0.3	1.0	0.6	56.36‖	<.001
Tier 2 (moderately severe)	0.0	0.5	0.0	0.3	3.7	3.7	1.1	1.5	2.1		
Tier 3 (mild)	4.4	16.6	8.3	12.3	15.3	21.2	27.6	19.6	23.5		
Tier 0 (none on list of comorbidities)	95.6	82.9	91.7	87.4	81.0	74.4	71.1	77.9	73.8		
Discharge destination (%)											
To community¶	93.3	94.7	96.7	95.2	98.4	96.0	95.6	95.5	95.7	4.94‖	.552
To other settings	6.7	5.3	3.3	4.8	1.6	4.0	4.4	4.5	4.3		
Process of care											
LOS	16.1±8.2	13.7±7.6	13.3±6.0	13.9±7.2	8.8±3.3	8.0±3.5	9.9±4.1	8.3±2.8	8.9±3.7	55.71	<.001
Intensity#	1.2±0.5	1.1±0.2	1.4±0.3	1.2±0.3	1.5±0.2	2.2±0.5	2.0±0.4	2.0±0.3	2.1±0.4	307.90	<.001

Source: JOINTS study.
NOTE. Values are mean ± SD or as otherwise indicated.
Abbreviations: Fs-SNF, freestanding SNF; Hb-SNF, hospital-based SNF; HMO, Health Maintenance Organization.
*CSI: one of the JOINTS study's principal severity adjusters.
†Onset days are the number of days from surgery to rehabilitation admission. In the case of joint replacement, this number is almost always the length of acute care immediately prior to the rehabilitation admission.
‡Hospital-based SNF: the JOINTS study's Hb-SNF was classified as a high-volume facility based on the volume of patients served by the Hb-SNF in 2006.
§Comorbidity tier based on comorbidity tiers used in Medicare's IRF prospective payment system.
‖F or χ^2, value is a comparison between 7 categories, 3 Fs-SNF groups, the Hb-SNF, and 3 IRF groups, using 1-way analysis of variance for continuous variables or χ^2 for discrete variables. χ^2 tests indicated by ‖.
¶Discharge to community is defined as discharge to home or assisted living.
#Total hours of PT and OT divided by LOS.

revisions and bilateral replacements than did the study's freestanding SNFs or IRFs.

Demographic, medical, and functional profile. In tables 4 and 5 we partition the study group by type of replacement (knee or hip), by facility type (freestanding SNF, hospital-based SNF, or IRF), and by annual facility volume of joint replacement patients served—low, medium, high, and very high volume.

The study's typical joint replacement patient was a woman in her early 70s with an average BMI in the low 30s (BMI ≥30 is obese). About 15% of patients were morbidly obese (BMI ≥40). About one third of all patients lived alone. SNF patients were on average almost 3 years older than their IRF counterparts.

IRF patients presented more severe medical and functional profiles on admission than SNF patients. IRF patients had higher CSI scores and lower FIM scores at admission. However, freestanding SNF and IRF patients presented similar rates of common comorbidities such as diabetes, hypertension, and ischemic heart disease; hospital-based SNF patients presented higher rates of these common comorbidities.

Because of their FIM scores, proportionately more SNF patients fell into one of the lower, less severe CMGs (801–802), while IRF patients, compared with SNF patients, were more likely to fall into 1 of the 4 more severe CMGs (803–806). For a definition of CMGs, see table 3 in the accompanying article by DeJong et al.[3]

Payer mix. Medicare was the dominant payer for patients in all 3 types of facilities and for both types of joint replacement. Non-Health Maintenance Organization Medicare was more common among freestanding SNF and hospital-based SNF patients (≈ 81%–84%) than among IRF patients (≈71%). IRFs had a more diverse payer mix with more patients who were enrolled in Medicaid or a commercial health plan, possibly because study IRFs served a slightly younger cohort, some of whom were not eligible for Medicare.

Process of Care

The typical patient with joint replacement came to an SNF or an IRF after a 4-day LOS in acute care. The average LOS for freestanding SNF patients, hip and knee combined, was 14.1 days, for hospital-based SNF patients 8.8 days, and for IRF patients about 9 to 10 days depending on whether the patient had a knee replacement (8.9d) or a hip replacement (10.1d). On a case-mix–adjusted basis, the average LOS for freestanding SNF patients was much longer than for IRF patients (see table 4 in the accompanying article by DeJong[3]).

An important difference between freestanding SNFs and IRFs is that freestanding SNFs provided less intensive services (h/d) over a longer period; IRFs provided more intensive services in a shorter period. Freestanding SNFs demonstrated a wider variation in LOS and intensity of therapy relative to IRFs. (For more on processes of care, see DeJong,[3] especially fig 1).

Outcomes

Functional status—descriptive analysis. Tables 4 and 5 indicate that, as measured by motor FIM, SNF patients entered rehabilitation at higher functional levels and left at higher functional levels; IRF patients entered at lower levels and left at lower levels. Overall, without case-mix adjustment, IRFs demonstrated larger gains in motor FIM scores than did freestanding SNFs for both patients with knee replacement (26.0 vs 21.1; $P<.001$) and patients with hip replacement (26.3 vs 22.0; $P<.001$).

There also were striking differences by facility volume. While there was little variation among IRFs in FIM gain, the 5 medium-volume IRFs (100–183 patients a year) had the largest gains from admission to discharge (27.0 for patients with knee replacement, 27.7 for patients with hip replacement). At the other extreme, 4 low-volume freestanding SNFs (20–45 patients a year) had the smallest FIM gains from admission to discharge (16.5 for patients with knee replacement, 18.1 for patients with hip replacement). There was nearly a 10-point spread in motor FIM gain between medium-volume IRFs and low-volume freestanding SNFs. The 3 medium-volume freestanding SNFs performed best among SNFs (22.2 for patients with knee replacement, 23.4 for patients with hip replacement).

Study IRFs achieved larger gains in shorter lengths of time and therefore demonstrated higher LOS efficiencies—that is, achieved more FIM gains a day—than did their SNF counterparts. The 5 medium-volume IRFs not only had the largest gains but also had shorter average LOS and therefore, as a class of facilities, had the highest LOS efficiencies.

The study's hospital-based SNF performed in the middle of the pack. In terms of FIM gain, the hospital-based SNF had higher motor FIM gains than study freestanding SNFs but lower gains than study IRFs. It achieved its FIM gains in an average of 8.8 days, making it more LOS-efficient than study freestanding SNFs.

Functional status—multivariate analysis. We present 3 sets of regressions in tables 6 through 8. All tables convey essentially the same findings, but their juxtaposition provides useful insights. The 2 most important patient predictors were the patient's admission motor and cognitive FIM scores. The next most important patient predictor was the patient's onset days (days from actual joint replacement to admission to postacute rehabilitation). Postacute setting explained less of the variation in outcomes.

In regression model 1 (see table 6), in which we only considered patient characteristics and setting, IRF entered positively ($P=.014$ for patients with knee replacement and $P=.005$ for patients with hip replacement). R^2 values were 0.325 for patients with knee replacement and 0.458 for patients with hip replacement. Table 6 combines the hospital-based SNF with the freestanding SNFs and thus compares all SNFs with IRFs. When we treat the hospital-based SNF as a setting distinct from freestanding SNFs, IRFs enter more positively, but all other relationships remain the same.

Regression model 2 (see table 7) refines model 1 by also considering other facility characteristics and process variables. We found that volume and therapy intensity—a defining difference between SNFs and IRFs—made a difference in outcome: those who received more intense therapy, akin to what is found in an IRF, had, on average, larger FIM gains (see table 7). When setting and therapy intensity are included in the same model as in table 7, therapy intensity masks the setting effect seen in table 6. More important, however, was the role of facility volume: medium-volume facilities demonstrated better risk-adjusted outcomes and low-volume facilities demonstrated worse risk-adjusted outcomes (for knee patients). Table 7 considers the hospital-based SNF as a distinct setting.

In regression model 3 (see table 8), we exclude therapy intensity because of its strong association with setting (eg, $r=.711$ among IRF patients with knee replacement), and instead considered volume-by-setting combinations as distinct facility types. We found that medium-volume IRFs had better outcomes and low-volume freestanding SNFs had worse outcomes as observed in descriptive analyses in tables 4 and 5. The spread between medium volume IRFs and low-volume

Table 5: Characteristics and Outcomes of Patients With Hip Replacements

Characteristic or Outcome	Fs-SNF				Hb-SNF‡	IRF				F or $\chi^{2\|}$	*P*
	Low Volume (n=10)	Medium Volume (n=108)	High Volume (n=72)	Total (n=190)	High Volume (n=77)	Medium Volume (n=159)	High Volume (n=211)	Very High Volume (n=114)	Total (n=484)		
Demographics											
Age (y)	74.0±11.9	76.3±9.1	71.1±11.8	74.3±10.6	73.5±7.6	68.9±12.7	71.0±12.6	69.4±11.3	69.9±12.3	5.78	<.001
Sex (% female)	70.0	73.2	75.0	73.7	67.5	59.8	66.8	64.0	63.8	8.15‖	.227
Race (% white)	100.0	97.2	29.2	70.9	100.0	84.9	75.4	92.1	82.4	183.19‖	<.001
Lived alone (%)	10.0	46.3	36.1	41.2	31.2	30.8	39.3	29.0	34.1	14.01‖	.030
Payer mix (% non-HMO Medicare)	70.0	82.4	93.1	85.4	84.4	61.6	68.3	80.7	69.0	44.51‖	<.001
Health and functional status											
Admission CSI*	13.9±9.2	11.5±8.1	22.3±7.9	15.7±9.6	15.1±8.7	19.3±13.1	23.0±13.1	19.9±11.8	21.0±12.9	15.15	<.001
BMI	27.4±5.1	28.9±6.1	31.8±6.4	29.9±6.3	30.6±6.8	30.1±7.2	29.0±6.6	29.3±6.0	29.5±6.7	2.39	.027
Admission motor FIM	43.8±14.0	47.5±8.2	47.8±7.3	47.4±8.2	46.0±8.2	39.2±8.2	38.9±8.6	39.3±8.7	39.1±8.4	26.08	<.001
Discharge motor FIM	61.9±22.5	70.9±7.4	68.0±8.4	69.4±9.3	69.3±6.3	66.9±7.3	64.0±10.3	65.9±8.6	65.4±9.1	9.48	<.001
Change in motor FIM	18.1±10.5	23.4±7.2	20.2±6.8	22.0±7.4	23.3±7.9	27.7±8.2	25.1±8.3	26.6±7.5	26.3±8.2	10.81	<.001
Admission cognitive FIM	29.8±5.9	32.6±4.7	34.5±3.1	33.2±4.4	30.0±3.1	28.7±5.6	28.0±6.4	31.0±3.6	29.0±5.7	26.08	<.001
Onset days†	6.4±4.9	4.9±3.3	3.0±2.4	4.3±3.2	3.5±1.5	4.3±2.0	4.7±4.4	3.6±1.8	4.3±3.3	6.14	<.001
CMG (%)											
801–802	50.0	57.4	61.1	58.4	64.9	31.5	32.2	42.1	34.3	78.44‖	<.001
803–804	30.0	27.8	31.9	29.5	22.1	33.3	33.7	44.7	36.2		
805–806	20.0	14.8	6.9	12.1	13.0	35.2	34.1	13.2	29.6		
Comorbidities (%)											
Morbid obesity (BMI ≥40)	0.0	4.6	13.9	7.9	10.4	6.9	4.7	5.3	5.6	10.84‖	.094
Hypertension	80.0	67.6	79.2	72.6	70.1	67.3	56.9	63.2	61.8	15.25‖	.018
Diabetes	30.0	13.0	19.4	16.3	22.1	25.2	16.1	12.3	18.2	12.29‖	.056
Ischemic heart disease	10.0	26.9	8.3	18.9	24.7	20.8	19.4	16.7	19.2	11.95‖	.063
Tier 1 (most severe)§	0.0	0.0	0.0	0.0	0.0	1.9	0.5	0.9	1.0	22.33‖	.218
Tier 2 (moderately severe)	0.0	0.9	0.0	0.5	1.3	1.3	2.8	1.8	2.1		
Tier 3 (mild)	10.0	10.2	9.7	10.0	10.4	14.5	20.9	11.4	16.5		
Tier 0 (none on list of comorbidities)	90.0	88.9	90.3	89.5	88.3	82.4	75.8	86.0	80.4		
Discharge destination (%)											
To community¶	70.0	94.4	100.0	95.3	97.4	96.2	82.9	95.6	90.3	47.62‖	<.001
To other settings	30.0	5.6	0.0	4.7	2.6	3.8	17.1	4.4	9.7		
Process of care											
LOS	17.5±8.3	16.1±8.8	11.7±8.0	14.5±8.7	8.9±3.5	9.6±5.2	11.2±5.1	8.6±3.4	10.1±4.6	24.14	<.001
Intensity#	1.1±0.5	1.1±0.2	1.3±0.3	1.2±0.3	1.5±0.2	2.1±0.5	2.0±0.4	1.9±0.3	2.0±0.4	139.30	<.001

Source: JOINTS study.
NOTE. Values are mean ± SD or as otherwise indicated.
Abbreviations: Fs-SNF, freestanding SNF; Hb-SNF, hospital-based SNF; HMO, Health Maintenance Organization.
*CSI: one of the JOINTS Study's principal severity adjusters.
†Onset days are the number of days from surgery to rehabilitation admission. In the case of joint replacement, this number is almost always the LOS in acute care immediately prior to the rehabilitation admission.
‡The JOINTS study's hospital-based facility (Hb-SNF) was classified as a high-volume facility based on the volume of patients served by the Hb-SNF in 2006.
§Comorbidity tier based on comorbidity tiers used in Medicare's IRF prospective payment system.
‖F or χ^2 value is a comparison between 7 categories, 3 Fs-SNF groups, the Hb-SNF, and 3 IRF groups, using 1-way analysis of variance for continuous variables or χ^2 for discrete variables. χ^2 tests indicated by ‖.
¶Discharge to community is defined as home or assisted living.
#Total hours of PT and OT divided by LOS.

Table 6: Results of OLS Regression Analysis in Predicting Discharge Motor FIM Score Using Setting (Regression Model 1)

	Knee Replacement				Hip Replacement			
Variable	Coefficient	F	*P*	Partial R^2	Coefficient	F	*P*	Partial R^2
Admission motor FIM	0.403	367.49	<0.001	0.275	0.466	207.65	<0.001	0.311
Admission cognitive FIM	0.238	38.81	<0.001	0.019	0.395	59.91	<0.001	0.046
IRF	0.901	6.00	0.014	0.003	1.639	8.12	0.005	0.007
Onset days	–0.281	20.16	<0.001	0.010	–0.545	46.24	<0.001	0.034
Revision	–2.212	9.55	0.002	0.013	–1.993	8.07	0.005	0.022
Race: white	1.697	15.52	<0.001	0.005	NA	NA	NA	
Admission CSI	NA	NA	NA		–0.069	10.69	0.001	0.038
R^2		0.325				0.458		
Adjusted R^2		0.322				0.453		

Source: JOINTS study.
Abbreviation: NA, not applicable.
*In this regression model, the hospital-based SNF is combined with freestanding SNFs. This regression model compares all SNFs with all IRFs.

freestanding SNFs was 4.6 motor FIM points for patients with knee replacement and 7.3 motor FIM points for patients with hip replacement. The results in table 8 suggest that facility volume differences observed in table 7 are driven mainly by medium-volume IRFs and low-volume freestanding SNFs. Among patients with knee replacement, medium-volume freestanding SNFs outperformed other freestanding SNFs as well as higher-volume IRFs. Findings in table 8 offer further explanation for the results found in table 6 and 7. Table 8 considers the hospital-based SNF as a distinct setting.

Multivariate analyses confirm the descriptive analyses, that facility type and volume are associated with discharge motor FIM scores after accounting for patient differences and differences in onset days. Regressions in tables 6 to 8 explained about one third of the variation in outcomes among patients with knee replacement and nearly one half of the variation in outcome among patients with hip replacement. We ran models both with and without the hospital-based SNF, and the findings were the same. The hospital-based SNF itself was never a predictor (negative or positive) of outcome.

In the logistic regression analyses, where FIM gain is treated as a dichotomous variable, we found the same predictor variables entered in both OLS and logistic regression models. With the exception of model 3, in which medium-volume SNFs are positively associated with knee replacement outcomes, all models suggest either IRF setting or characteristics correlated with IRFs (eg, intensity of therapy) are associated with better functional outcomes.

Figure 1 summarizes the findings from models 1 and 3, in which setting effects were observed. For each model, figure 1 depicts the mean values associated with the setting effects and their 95% confidence intervals. Figure 1 also underscores the wider range of outcome values seen in SNFs than in IRFs.

Discharge destination. Among patients with knee replacement, there was virtually no difference between SNFs and IRFs in whether a patient was discharged to a community or institutional setting. This was not always the case with patients with hip replacement: patients discharged from low-volume freestanding SNFs were less likely to go home (70%), while more than 95% of patients from other facilities returned to the community. The only exception was among high-volume IRFs, where 82.9% went home.

DISCUSSION

The study's principal question is how type of setting is associated with functional outcomes at discharge. In the descriptive analyses, IRF patients present more medical acuity and more functional limitation on admission, and make larger gains. In multivariate analyses, the relationship continues to hold when IRF is allowed to enter the model, although the IRF advantage overall is modest. The relationship between setting and outcome is less direct when we consider therapy intensity.

Table 7: Results of OLS Regression Analysis in Predicting Discharge Motor FIM Score Using Therapy Intensity (Regression Model 2)

	Knee Replacement				Hip Replacement			
Variable	Coefficient	F	*P*	Partial R^2	Coefficient	F	*P*	Partial R^2
Admission motor FIM	0.404	382.54	<0.001	0.275	0.443	202.10	<0.001	0.274
Admission cognitive FIM	0.235	38.94	<0.001	0.019	0.391	59.65	<0.001	0.041
Medium volume	1.642	21.04	<0.001	0.010	2.614	25.54	<0.001	0.018
Onset days	–0.283	20.67	0.002	0.009	–0.544	47.59	0.001	0.030
Revision	–2.132	9.03	0.003	0.013	–2.349	11.42	0.001	0.021
Race: white	1.282	8.64	0.003	0.005	NA	NA	NA	NA
Therapy intensity	0.940	8.22	0.004	0.006	1.832	13.31	0.003	0.013
Low volume	–2.291	5.61	0.018	0.005	NA	NA	NA	NA
Admission CSI	NA	NA	NA	NA	–0.058	7.68	0.006	0.042
Age	NA	NA	NA	NA	–0.048	4.88	0.028	0.045
R^2		0.342				0.484		

Source: JOINTS study.
NOTE. Therapy intensity is total hours of PT and OT combined, divided by LOS.
Abbreviation: NA, not applicable.

Table 8: Results of OLS Regression Analysis in Predicting Discharge Motor FIM Score Using Facility Type by Facility Volume but Not Therapy Intensity (Regression Model 3)

	Knee Replacement				Hip Replacement			
Variable	Coefficient	F	*P*	Partial R^2	Coefficient	F	*P*	Partial R^2
Admission motor FIM	0.400	370.46	<0.001	0.188	0.465	236.20	<0.001	0.184
Admission cognitive FIM	0.250	41.94	<0.001	0.110	0.442	76.32	<0.001	0.191
Onset days	–0.302	23.51	<0.001	0.011	–0.558	50.36	<0.001	0.037
Revision	–2.298	10.52	0.001	0.006	–2.482	12.92	<0.001	0.008
Race: white	0.927	4.17	0.041	0.001	NA	NA	NA	NA
IRF, medium vol.	1.596	14.27	<0.001	0.007	2.277	14.22	<0.001	0.009
Fs-SNF, high vol.	–2.111	10.61	0.001	0.010	–4.165	22.77	<0.001	0.018
Fs-SNF, medium vol.	1.141	4.56	0.033	0.004	NA	NA	NA	NA
Fs-SNF, low vol.	–2.965	9.52	0.002	0.005	–5.001	5.64	0.018	0.004
Admission CSI	NA	NA	NA	NA	–0.047	5.09	0.024	0.034
R^2		0.343				0.485		

Source: JOINTS study.
Abbreviations: Fs, freestanding; NA, not applicable; vol., volume.

More intense therapy—for example, more hours of PT and OT a day, seen in IRFs—is associated with better outcomes.

Annual facility volume of patients with joint replacement also plays a role, which becomes more pronounced when we consider its interaction with facility type. Low-volume and high-volume SNFs did not do as well as medium-volume SNFs and medium-volume IRFs. We were not able to test this finding with low-volume IRFs because the study's initial facility recruitment and selection strategies favored higher-volume facilities; low-volume SNFs came into the study because of difficulties in recruiting SNFs of any volume. We cannot say from this study what the minimum patient volume should be for a facility to be active in this patient segment and type of care.

This article examines outcomes across 3 settings of care. While there are noticeable differences among the 3 settings (eg, intensity of therapy), there are also noticeable differences within settings, especially among freestanding SNFs. We found significant variation in days from surgery to freestanding SNF admission (onset days), freestanding SNF LOS, intensity of therapy, and outcomes. As in the Buntin et al[4] study, we found larger SDs in SNF LOS than in IRF LOS. Study IRFs demonstrated a more consistent set of practice patterns and outcomes.

This study corroborates findings from other studies. For example, we found that obesity, while a potential risk factor for joint replacement itself, was not strongly associated with outcomes.[28-31] Likewise, higher patient volume is associated with better outcomes for many conditions and procedures including total knee replacement,[32] total hip replacement,[33] pelvic reconstructive surgery,[34] total shoulder replacement,[35] intensive care,[36] diabetic care,[37] scoliosis with spinal fusion,[38] and coronary artery bypass surgery.[39] While most of these studies show a linear relationship between volume and outcome, our study found a curvilinear relationship where medium volumes are associated with better outcomes.

Implications for Practice and Policy

One needs to consider whether study findings, though statistically significant, also are significant from a clinical and policy perspective. Some differences may be a result of measurement error as well as true differences, and this is especially important when smaller differences are observed. Previous studies have suggested that increases of 2 FIM points are clinically important because they are associated with a reduction of 6 to 10 minutes of personal assistance a day.[40-45]

Fig 1. Discharge motor FIM scores and 95% confidence intervals for patients with knee and hip replacement discharged from SNFs and IRFs, adjusted for patient differences. *Model 1b is the flip side of model 1a shown in table 6. Model 1b forces in the all-SNF variable and uses IRF as the reference group. Model 2 based on table 7 is not shown because it includes no setting effects (setting effect obscured by therapy intensity). Abbreviations: med., medium; vol., volume.

Clinical significance does not automatically translate into policy significance, however, because policy makers may be willing to tolerate a 2-point difference in the face of other considerations such as costs, a consideration that lies beyond the scope of this article. We can safely say, for example, that a 10-point difference in FIM gain is compelling; a 3 to 5 point difference is less so, but still material when one considers what this means for daily caregiver burden; a 2-point or smaller difference is less decisive.

While we started this study asking which setting of care provides superior functional outcomes for patients with joint replacement and though we find that the findings tilt in favor of IRFs, study results require a more nuanced interpretation. First, intensity of therapy is associated with outcomes—and facility type, SNF or IRF with their respective therapy intensities, needs to be considered when making a postacute placement. The fact that freestanding SNFs and IRFs provide, on average, similar amounts of total therapy,[3] suggests even more strongly that intensity, as found in IRFs, is associated with better outcomes—at least at discharge. This finding is in keeping with previous research on patients with stroke served by IRFs[46] and research among patients with stroke, orthopedic, cardiovascular, and pulmonary conditions in SNFs.[47]

Second, onset days—number of days from surgery to rehabilitation admission—is associated with motor FIM gain at discharge. Despite ever decreasing LOS in acute care, starting rehabilitation earlier is associated with better outcomes: every day counts. This finding corroborates the study by Munin et al[48] in which, in a limited randomized trial (N=71), they observed that patients with joint replacement who started rehabilitation on day 3 after a joint replacement had better functional outcomes than those who did not start until day 7. This finding suggests that more may need to be done to facilitate the hand-off from acute care to rehabilitation as early as possible.

Third, a facility's volume of patients with joint replacement is associated with outcome, and low volumes are associated with worse outcomes. Centers for Medicare and Medicaid Services and other health plans should consider excluding facilities that do not serve a certain minimum number of patients with joint replacement. Low-volume facilities not only had more onset days but also had worse outcomes after onset days were taken into account in regression analysis. It is possible that low-volume facilities cannot achieve the scale and proficiency needed to facilitate good outcomes. We observed that medium-volume facilities do best among both IRFs and SNFs, but we do not know where the sweet spots are between low and medium volumes or between medium and high volumes.

The volume effect also has implications for the 75%/60% rule cited in the introduction. Under the 75%/60% rule, smaller IRFs were unable to admit higher volumes of patients with joint replacement and achieve the specialization and proficiency needed for good outcomes. We need to underscore that we were unable to test this directly because small IRFs serving low volumes of patients with joint replacement were not represented in the study. Nonetheless, the 75% rule may have had unintended consequences when it restricted volumes of certain types of patients. This needs to be studied further, although the new 60% rule gives facilities greater latitude in who can be admitted and thus in achieving the volumes needed for more proficient care.

Fourth, we observed considerable within-setting variability, especially with respect to LOS, therapy intensity, and outcomes among SNFs. SNFs with the longest LOS and least intense services performed least well. These were predominantly low-volume SNFs. Medium-volume SNFs did much better. Thus, there may be important choices to be made within types of facilities as well as between types of facilities.

Finally, there is the question of how to view hospital-based SNFs—as a class by themselves or in a class with other SNFs. In our analysis of joint replacement rehabilitation processes,[3] we observed noticeable differences between the hospital-based SNF and study freestanding SNFs. The presence of hospital-based SNFs obscures the comparison between the 2 payment systems, SNF-PPS and IRF-PPS. According to the Medicare Payment Advisory Commission, hospital-based SNFs have large negative margins (−83.8%).[49] Hospitals must make up their SNF costs from other payers—for example, the Medicare diagnosis-related group payment for acute care. In short, we may be comparing 3 payment systems—IRF-PPS, SNF-PPS, and SNF-PPS cross-subsidized by other payers. This indirect cross-subsidy blurs 1 of the key distinctions that motivated this study. Large negative hospital margins may also account for why there were 521 or 30% fewer hospital-based SNFs in 2006 than in 2001 and why they now comprise only 8.1% of all SNFs.

Study Limitations and Generalizability of Study Findings

The study achieved geographic diversity by successfully enrolling SNFs and IRFs from all 4 of the nation's major census areas. However, all facilities participated voluntarily and thus self-selected into the study. In short, we have a convenience sample but a geographically diverse one. Low-volume IRFs, especially smaller IRF units in acute care hospitals, were not represented in the study, and their participation would have strengthened study findings with respect to low volumes and increased generalizability to all IRFs. Given variability and diversity of SNF practice patterns and lower numbers of SNF study patients, the study would have benefited from participation of more SNFs relative to IRFs. Overall, it is likely that the study attracted above-average facilities of both kinds. Thus, we recommend caution in generalizing to all SNFs and all IRFs nationally.

This study used a common outcome metric—motor FIM—to compare joint replacement rehabilitation outcomes across settings of care. FIM is not without its challenges, however. Scoring on some FIM items can vary with local practice patterns in how patient care is managed and thus observed. For example, if a patient is admitted with a temporary Foley catheter, the patient will have a lower FIM score than if he or she were admitted a day later without a catheter. The effects of such differences are probably marginal. Also, IRFs use FIM for payment purposes and are very familiar with its definitions and rules. SNFs do not use FIM regularly, so even with training and checking for reliability, they may not have been as accurate in FIM scoring throughout the project.

It is also important to underscore what this article does not address. First, this article does not address the effects of specific types of therapy activities (eg, exercise, gait, dressing upper body) that patients may have received. What is more important, perhaps, is not where patients obtain therapy, but what therapy patients actually receive regardless of the setting.[50] Then the setting or settings can be selected that are best able to deliver such care. While the JOINTS study is powered to answer this best practices question, we do not address it here. Second, this article does not address the role of nursing, a major component of the inpatient experience. While we attempted to collect nursing POC data, compliance was uneven. Third, while this article addresses outcomes and LOS efficiency (FIM gain/LOS), it does not address payment efficiency—for example, outcome per dollar payment or

cost-effectiveness. Fourth, this article addresses only outcomes on discharge; it does not address longer-term outcomes at follow-up such as postdischarge complications, functional status, general health, hospital readmissions, and resumption of premorbid social roles.

To some extent, the SNF–IRF dichotomy presents an incomplete choice. It suggests that there has to be a winner and loser in the policy debate about the merits of SNF and IRF care for patients who have had a joint replacement. We already have suggested that patient volume may play a role among both SNFs and IRFs. Hence, the choice may not be just between SNF and IRF. There also may be important choices to be made within types of facilities.

The SNF–IRF dichotomy may also be a false choice. Another way to frame the issue is to ask which patients do better in an SNF, which do better in an IRF, and for which patients it makes little or no difference. This article does not address this question head on and is the subject of future analysis. We have framed this article largely in the context of the current policy debate.

SNF–IRF comparisons are not straightforward. Given the variation within these settings as well as between them, generalizations can only be made cautiously. Ideally, one might want to conduct a randomized trial, but these 2 settings lack the uniformity and consistency in practice—especially among SNFs—that a randomized trial presumes. Public policy would be well served if the focus could shift to what is best practice in both settings of care in order to identify a next generation of practice that transcends the SNF–IRF dichotomy.

CONCLUSIONS

Patients with joint replacement in study SNFs come in with higher functional scores and leave with higher functional scores than IRF patients. Study IRF patients, however, experience a larger net motor functional gain and achieve these gains in a shorter period. Multivariate analyses, controlling for patient differences and onset days, indicate that IRFs are associated with better outcomes, but the size of the setting effect is not large.

We found that therapy intensity, a practice feature strongly associated with IRFs, was positively associated with functional outcome. Apart from intensity effect, the study found that interaction between setting and annual volume of patients with joint replacement was a stronger predictor of outcome than setting alone. Medium volume SNFs and IRFs had better outcomes; high-volume and low-volume freestanding SNFs had worse outcomes. The study uncovered as much practice variation (in terms of therapy intensity and LOS) within settings, especially among SNFs, as between settings. Large practice variations within settings can obscure distinctions between settings.

In short, overall study findings favor IRF-level care, but the IRF advantage is not clear-cut. The choice of postacute setting also needs to take into account other important facility and practice characteristics such as therapy intensity and a facility's volume of joint replacement rehabilitation patients.

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