

# Comparison of Functional Outcomes Associated with Hospital at Home Care and Traditional Acute Hospital Care

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**OBJECTIVES:** To compare differences in the functional outcomes experienced by patients cared for in Hospital at Home (HaH) and traditional acute hospital care.

**DESIGN:** Survey questionnaire of participants in a prospective nonrandomized clinical trial.

**SETTING:** Three Medicare managed care health systems and a Veterans Affairs Medical Center.

**PARTICIPANTS:** Two hundred fourteen community-dwelling elderly patients who required acute hospital admission for community-acquired pneumonia, exacerbations of chronic heart failure or chronic obstructive pulmonary disease, or cellulitis, 84 of whom were treated in HaH and 130 in an acute care hospital.

**INTERVENTION:** Treatment in a HaH care model that substitutes for care provided in the traditional acute care hospital.

**MEASUREMENTS:** Change in activity of daily living (ADL) and instrumental activity of daily living (IADL) scores from 1 month before admission to 2 weeks post admission to HaH or acute hospital and the proportion of groups that experienced improvement, no change, or decline in ADL and IADL scores.

**RESULTS:** Patients treated in HaH experienced modest improvements in performance scores, whereas those treated in the acute care hospital declined (ADL, 0.39 vs -0.60,  $P = .10$ , range -12.0 to 7.0; IADL 0.74 vs -0.70,  $P = .007$ , range -5.0 to 10.0); a greater proportion of HaH patients improved in function and smaller proportions declined or had

no change in ADLs (44% vs 25%,  $P = .10$ ) or IADLs (46% vs 17%,  $P = .04$ ).

**CONCLUSION:** HaH care is associated with modestly better improvements in IADL status and trends toward more improvement in ADL status than traditional acute hospital care. *J Am Geriatr Soc* 57:273-278, 2009.

**Key words:** hospital at home; hospital care; functional status; activities of daily living; instrumental activities of daily living

The decline in functional capacity experienced by hospitalized older persons is well recognized<sup>1,2</sup> and has engendered the development of hospital-based interventions such as Acute Care for Elder Units<sup>3</sup> and the Hospital Elder Life Program.<sup>4</sup> A complementary approach to this problem is to have acutely ill older patients avoid the inpatient hospital environment entirely by delivering acute hospital-level care at home, in a Hospital at Home (HaH) program.<sup>5</sup> Apart from potential benefits in functional outcomes, the rationale for HaH is that, in the home setting, older persons may receive high-quality care associated with fewer iatrogenic complications, higher patient and caregiver satisfaction, higher caregiver satisfaction, and lower caregiver stress and costs, outcomes that were demonstrated in a recent National Demonstration Study of HaH.<sup>6-8</sup>

Most studies examining functional outcomes associated with various HaH interventions have shown no difference between home- and hospital-treated groups.<sup>9-11</sup> When differences have been seen, they have been limited to improvements in instrumental activities of daily living (IADLs), as in a recent Australian study.<sup>12</sup> In that study, HaH patients were required to have a caregiver present in the home, and there were limited data on the patients' informal assistance that would have been important in understanding patients' ability to manage activities.

The aim of this study was to compare functional outcomes associated with HaH care with those associated with traditional acute hospital care and to explore patient

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characteristics associated with changes in function during the episode of acute medical illness. It was hypothesized that HaH care would be associated with greater improvements in functional capacity than traditional acute hospital care.

## METHODS

### Patients and the HaH Model of Care

The target population was community-dwelling persons aged 65 and older, residing within a specific catchment area, who required acute hospital admission for an exacerbation of chronic obstructive pulmonary disease (COPD) or chronic heart failure (CHF), community-acquired pneumonia (CAP), or cellulitis and who met previously validated HaH eligibility criteria.<sup>13</sup> These patients were identified, provided consent, and were transported home in an ambulance. The HaH nurse met the ambulance at home and provided initial direct one-on-one care for a mean of 16.9 hours. After direct nursing supervision, the patient had intermittent nursing visits at least daily. Patients were not required to have a caregiver in the home, and if a caregiver was available, there was no requirement that the caregiver provide assistance or care to the patient. The HaH physician made at least daily home visits and was available at all times for urgent visits. A partner Medicare-certified home health agency provided nursing and other care components such as durable medical equipment, oxygen therapy, skilled therapies, and pharmacy support, and independent contractors provided some services (e.g., home radiology).

### Study Design

The HaH National Demonstration and Evaluation Study, previously described,<sup>6</sup> was conducted in three Medicare managed care plans and a Veterans Affairs Medical Center. The overall study was a prospective nonrandomized clinical trial conducted in two consecutive 11-month phases with 455 patients. A randomized study was precluded because of federal regulations related to Medicare managed care. During the acute hospital observation phase (November 1, 2000–September 30, 2001), eligible patients were identified and followed through usual hospital care. No patients were offered HaH care during the observation phase. During the intervention phase (November 1, 2001–September 30, 2002), eligible patients were identified at the time of admission and offered the option of receiving their care in HaH rather than the hospital. This report, as with recent previous reports,<sup>7,8</sup> was restricted to intervention-phase subjects only and employed an “as treated” approach, comparing those patients who were treated in the HaH with those treated in the acute care hospital. This latter group consisted of those who were offered and refused HaH care and those who were not offered HaH care because they were admitted from 10:00 p.m. to 6:00 a.m., when HaH did not accept new admissions. This “as treated” analytical approach seems more appropriate in this circumstance, because it examines potential differences in functional status between patients who experienced care in these distinct settings.

## Measurement

### Outcome Variables

Functional status was measured as five activities of daily living (ADLs) (eating, bathing, dressing, toileting, and transferring)<sup>14</sup> and seven IADLs (managing money, managing medications, preparing meals, shopping, doing light or heavy housework, using the telephone).<sup>15</sup> To capture declines in functional capacity before a complete transition from fully independent to fully dependent status, an extended scoring metric was used for ADLs. Patients were asked whether they had no difficulty, used special equipment, needed standby assistance, needed actual physical assistance, or did not perform a task because of a health or physical problem, with a possible score of 0 (fully independent) to 28 (fully dependent). For IADLs, patients were asked whether they had no difficulty, received help from another person or did not do because of health or physical problem, with a possible score of 0 (fully independent) to 14 (fully dependent). Assessment of function was obtained in an in-person interview during the first 24 hours of admission, when study personnel asked the patient to think back to about 1 month before the acute admission about their functional capacity. A survey research firm not privy to study hypotheses asked the same questions in a telephone interview at 2 weeks postadmission. The primary outcomes were change in ADL and IADL score from 1 month pre-admission to 2 weeks post-acute admission and the proportion of patients who improved in their function and that of those who stayed the same or declined, as measured according to the respective ADL and IADL scores.

### Independent Variables

Characteristics of patients obtained in interviews during the acute care episode were age (dichotomized as  $\geq 75$  vs  $< 75$ ), sex, race, and whether the patient lived alone. Indicators of health status were the primary admission diagnosis, illness severity at time of admission as measured according to the Acute Physiology and Chronic Health Evaluation II score<sup>16</sup> (dichotomized as  $\geq 16$  vs  $< 16$ ), comorbid conditions abstracted from the medical record (dichotomized as  $\geq 6$  vs  $< 6$ ), symptoms of depression as measured according to the 15-item Geriatric Depression Scale (GDS)<sup>17</sup> (dichotomized as no symptoms of depression present (score 0–5) vs moderate to severe symptoms of depression present (score  $\geq 6$ )), cognitive function as measured according to the Mini-Mental State Examination (MMSE)<sup>18</sup> (dichotomized as no cognitive impairment (score  $\geq 24$ ) vs cognitive impairment present (score  $< 24$ )), and whether the patient received formal physical or occupational therapy services during the acute admission.

### Analysis

The analysis was restricted to intervention-phase subjects only, and an “as treated” approach was employed, comparing patients who were treated in the HaH with those treated in the acute care hospital. Analysis was conducted on a complete-case basis. Characteristics of the HaH and traditional acute care hospital population were compared using the *t*-test, the chi-square test, or the Fisher exact test, as appropriate. Mean change function scores were evaluated using *t*-tests. The change in scores for ADLs and IADLs

was the difference in scores between 2 weeks postadmission and baseline (1 month before admission). Differences in proportions of patients who improved, declined, or had no change overall, or in specific domains of function, were compared using chi-square tests. To explore the question of what factors were associated with improvement in function, logistic regression was used to determine whether there was an independent relationship between site of treatment and change in function for ADLs and IADLs, adjusting for site of treatment (HaH vs acute care hospital) and for the independent variables listed above that were associated with functional outcomes in bivariate analyses at a statistical significance level of  $P < .05$ . Baseline functional status was not adjusted for.<sup>19</sup> Odds ratios (ORs) and 95% confidence intervals (CIs) are reported.

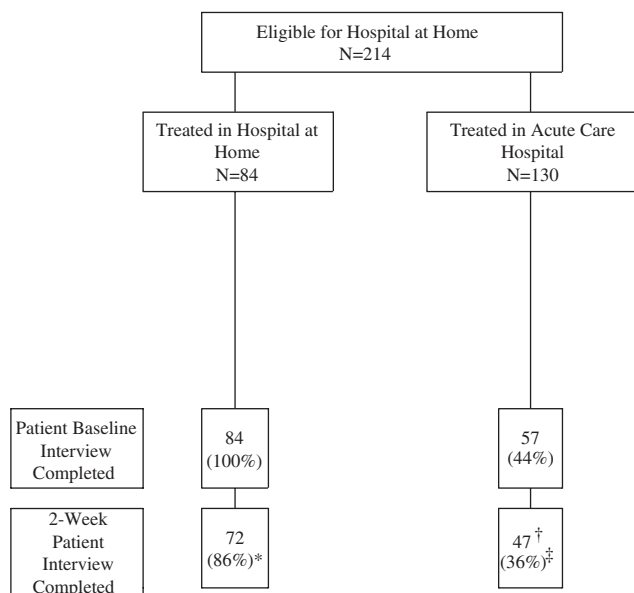
**Approval**

The study received approval from the institutional review board at each study site, the coordinating center, and officials at the Center for Medicare and Medicaid Services. Informed written consent for participation was obtained from all participants.

**RESULTS**

Patient flow and data availability are depicted in Figure 1. Two hundred fourteen patients were eligible for HaH during the intervention phase of the study, of whom 84 were treated in HaH and 130 in the acute care hospital, because they declined HaH treatment or were missed for HaH enrollment because they presented for admission at times when HaH did not accept admissions. Baseline and 2-week follow-up interview data on functional status were available for 72 (86%) of the HaH-treated group and 47 (36%) of the acute care hospital group, although the re-

spective proportion of participants consenting to data collection who also completed interviews were similar between the HaH (86%) and acute care hospital (82%) groups. It is likely that the consent and complete case rates reflect the low incentive for intervention phase patients treated in the acute hospital to participate in a study with a high interview burden. In the acute care hospital group, there were no differences in baseline sociodemographic and health status characteristics between those who refused to have a baseline interview ( $n = 73$ ) and those who completed one ( $n = 57$ ), except the former group was more likely to be female (55% vs 26%,  $P = .001$ ). There were no differences in the acute care hospital group between those who completed a 2-week interview and those who completed only a baseline interview. There were no differences in the HaH group between those who completed a 2-week interview and those who completed only a baseline interview. Table 1 describes the baseline characteristics of the study populations. The HaH and acute care hospital groups were similar, except that at baseline HaH patients were more functionally impaired in ADLs and IADLs. In addition, there were trends for HaH patients to experience a shorter length of stay and be less likely to have received formal physical



**Figure 1.** Patient flow and data availability according to study group.

\*Percentage of all patients treated in Hospital at Home.  
 †There were 47 2-week patient interviews; two were completed by proxy.  
 ‡Percentage of all patients treated in the acute care hospital.

**Table 1. Characteristics of the Study Population**

Characteristic	Hospital at Home n = 72	Acute Care Hospital n = 47	P-Value
Age, mean ± SD	77.0 ± 6.9	76.9 ± 7.2	.98
Aged ≥75, n (%)	44 (61.1)	29 (61.7)	.95
Female, n (%)	22 (30.5)	12 (25.5)	.55
Caucasian, n (%)	62 (86.1)	43 (91.5)	.37
Education ≥high school, n (%)	47 (65.2)	28 (59.6)	.56
Baseline activity of daily living score, mean ± SD (range 0–28)*	2.9 ± 3.3	1.8 ± 2.6	.04
Baseline instrumental activity of daily living score, mean ± SD (range 0–14)*	4.7 ± 3.8	2.5 ± 3.1	.001
Lives alone, n (%)	27 (37.5)	16 (34.0)	.70
Mini-Mental State Examination score ≥24, n (%)	54 (75.0)	38 (80.9)	.46
Geriatric Depression Scale-15 score ≥6, n (%)	27 (37.5)	15 (31.9)	.46
Diagnosis, n (%)			
Chronic heart failure	17 (23.6)	9 (19.1)	
Chronic obstructive pulmonary disease	22 (30.6)	8 (17.0)	
Pneumonia	20 (27.8)	19 (40.4)	
Cellulitis	13 (18.1)	11 (23.4)	.25
Length of stay, days, mean ± SD	2.8 ± 2.1	3.7 ± 2.6	.05
Number of comorbid conditions ≥6, n (%)	42 (58.3)	23 (48.9)	.31
Acute Physiology and Chronic Health Evaluation II score ≥16, n (%)	8 (11.1)	4 (8.5)	.65
Received formal physical or occupational therapy services during acute episode of care in respective care site, n (%)	4 (5.6)	19 (40.4)	<.001
Received post-acute admission home health services, n (%)	26 (36.1)	17 (36.1)	.10

\* Higher number indicates greater impairment.  
 SD = standard deviation.

**Table 2. Changes in Function Scores from 1 Month Before to 2 Weeks After Admission**

Function	Hospital at Home, n = 72	Acute Care Hospital, n = 47	P- Value
	Mean ± Standard Deviation (Range)		
Activities of daily living	0.39 ± 3.13 (-12.0-7.0)	-0.60 ± 3.09 (-12.0-6.0)	.10
Instrumental activities of daily living	0.74 ± 2.86 (-6.0-10.0)	-0.70 ± 2.68 (-5.0-10.0)	.007

Note: Positive number indicates improvement in functional capacity; negative number indicates decline in functional capacity.

or occupational therapy consultations during their acute episode of care.

Table 2 describes the change in ADL and IADL scores from 1 month before to 2 weeks after admission. The HaH group experienced improvement in ADL and IADL capacity, whereas the acute care hospital group experienced declines. The differences, on average, were modest, although wide ranging, and were statistically significant in the case of IADLs.

Figure 2 depicts the proportion of patients who improved in overall ADL or IADL function, declined, or remained the same. A greater proportion of HaH patients improved, and smaller proportions declined or had no change in ADL ( $P = .10$ ) and IADL function ( $P = .04$ ). For individual ADL and IADL tasks, a statistically significant proportion of HaH patients improved, and smaller proportions declined or had no change in toileting, medication use, heavy house work, and shopping.

HaH care was associated with greater odds of experiencing an improvement in function than declining or static function (ADL: OR = 3.8, 95% CI = 1.4-10.4; IADL: OR = 5.9, 95% CI = 2.0-17.3) in separate logistic regression models that also controlled for age, sex, race, length of

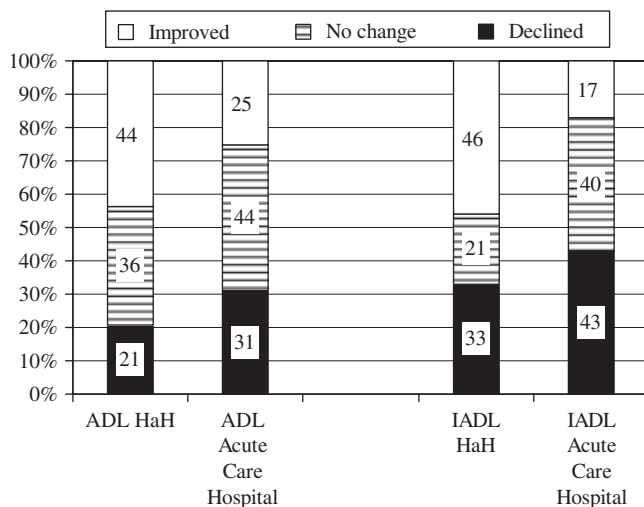
stay, and whether the patient received formal occupational or physical therapy services during the acute care episode. These results should be interpreted with appropriate caution given the wide CIs surrounding the point estimates, which probably reflect the small number of study subjects.

## DISCUSSION

This prospective, nonrandomized trial of HaH found that, on average, patients treated in HaH had greater improvement in their ability to perform IADLs than patients treated in the traditional acute hospital. In logistic regressions models, treatment in HaH was associated with greater odds of improvement in ADLs and IADLs.

Functional decline experienced by older persons associated with hospitalization has been previously described<sup>1,2,20</sup> and is known to be associated with adverse outcomes, including nursing home placement<sup>21</sup> and future acute illness.<sup>22</sup> The specific mechanisms of functional decline in older hospitalized patients are unclear; formal and informal activity restrictions with attendant decline in muscle function, polypharmacy, and other hazards of hospitalization may contribute.<sup>2,23,24</sup> The literature examining predictors of functional decline in hospitalized older persons demonstrates a wide variety of associated factors, including cognitive status, age, medical diagnosis, living in a nursing home, baseline functional status, and delirium. The patients examined in the current study were multimorbid and had such risks in abundance, and in logistic regression analyses controlling for covariates potentially associated with functional change, treatment in HaH was the only factor that was associated with improvement. It was hypothesized that, in HaH care, by virtue of patients being treated in their own homes, activity restrictions would be minimized, patients would feel more comfortable remaining active in a familiar environment, and the course of care would be less technically oriented and thus avoid functional decline. To the extent that acute conditions affect functional capacity, that premorbid status in the two groups was similar, and that the duration of the delivery of acute care services was brief, the difference in functional outcomes is all the more striking. The improvement in functional status for HaH patients and the decline in scores for acute care hospital patients occurred despite the fact that fewer HaH than acute care hospital patients received formal physical therapy consultations during their acute care admission.

There have been several previous studies of functional outcomes associated with substitutive HaH care. Most have demonstrated no difference in outcomes. A recent randomized controlled study of a substitutive Australian HaH for older persons demonstrated improvements in IADLs and no change in ADLs.<sup>12</sup> The proportion of HaH patients that demonstrated improvements was greater in the current study and may reflect selection bias inherent in the non-randomized design, although it may also reflect specific features of the HaH model in the current study in that the model did not require caregiver inputs and had a more robust physician component and that the length of stay (which may be reflective of physician inputs or differences between the U.S. and Australian healthcare systems) was shorter (3 days vs approximately 10 days).



**Figure 2.** Percentage of each group according to change in function. HaH = Hospital at Home; ADL = activity of daily living; IADL = instrumental activity of daily living.

The main strength of the study is that it is one of few studies of substitutive HaH care to assess functional outcomes. In addition, patients were asked to estimate their baseline functional status 1 month before their hospital event. Previous studies have suggested that this may be a better anchor point than 2 weeks before or at the time of hospital admission, because decline in function may be a prehospital phenomenon.<sup>25,26</sup> Also, recognizing that subtle but important changes in functional capacity can occur that may standard ADL assessment not capture,<sup>27</sup> an extended measure of function was employed. Finally, multivariate studies controlling for the effects of covariates that may have affected functional outcomes were performed in determining the independent effect of HaH on functional outcomes.

Although this study shows a positive effect, there are several important limitations. It is likely that some of the differences between study groups were due to selection bias, given that the patients could not be randomly assigned to treatment. It is likely that the differences in baseline functional status reflect this bias. It is likely that there was a ceiling effect present in that a lower proportion of patients in the HaH group than in the hospital-treated group had no IADL impairment (15% vs 40%). In addition, there were differences in the response rates between the HaH and acute care hospital patients, which probably introduced additional bias into the data. However, in both groups, similar proportions of participants who agreed to data collection completed 2-week data. Recall bias may have also affected the results to the extent that patients were asked to recall their functional status 1 month before the acute illness precipitating their hospital event.

This HaH model has been associated with a number of positive outcomes, including reductions in geriatric complications, lower costs, better patient and caregiver satisfaction, and reductions in caregiver stress.<sup>6–8</sup> This analysis of the effect of HaH on functional status provides data supporting the face validity that certain persons with acute illness treated in their home setting with HaH may experience advantages over those treated in the hospital. Even if selectively impaired patients choose HaH and experience good functional outcomes, that outcome should be viewed in a positive light. As the U.S. healthcare system faces increasing numbers of older adults who need the level of acute care that HaH offers, the importance of finding that such treatment is not necessarily damaging to improvement in function (and may have an advantage) takes on added importance.

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