Hospitalization Predicts Functional Decline in Nursing Home Patients.

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI‘I AT MĀNOA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTERS DEGREE

IN

BIOMEDICAL SCIENCE

May 2016

by

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ACKNOWLEDGEMENTS

This research was supported by: NCRR grant 1 R25 RR019321 "Clinical Research Education and Career Development (CRECD) in Minority Institutions"; the John A. Hartford Foundation Center of Excellence in Geriatrics, Department of Geriatric Medicine, University of Hawaii; the Hawaii Community Foundation grant 09ADVC-44274; Grant U54 MD007584 (NIMHD/NIH); Grant U54 RR026136 (NCRR); “RCMI Multidisciplinary And Translational Research Infrastructure EXpansion, (RMATRIX)”; and the Litchman Family

The candidate would like to thank the following individuals for their support in development of this thesis project:

Christina Bell: Study concept and design, data collection, analysis and interpretation of data, preparation of thesis.

Kamal H. Masaki: Study concept and design, acquisition of data, analysis and interpretation of data, preparation of thesis.

Rosanne Harrigan: Study concept and design, critical revision of thesis.

James Davis: Study concept and design, analysis and interpretation of data, preparation of thesis.

Karen Lubimir: Data collection.

Meiko Kuriya: Data collection.

Tina Grandinetti: Database preparation.
Abstract

Objectives: According to CMS data, a higher percentage of nursing home (NH) patients in Hawaii demonstrated functional decline than the national average. We examined the effects of hospitalization on functional and cognitive decline in elderly NH patients.

Design: Longitudinal observational study.

Setting: A 170-bed hospital-affiliated NH in Honolulu, Hawaii.

Participants: All patients admitted to the study NH between January 2003 and December 2006 (n=238) and followed from admission until discharge or death through 6/30/2011, using Minimum Data Set (MDS) assessments, NH and hospital medical records. We excluded patients with total Activities of Daily Living (ADL) dependence or severe cognitive impairment (Cognitive Performance Scale CPS=6) at baseline.

Measurements: Our primary outcome was change in function, measured by the MDS-ADL scale (range 1-28, higher=more disability) from admission and quarterly assessments. Our secondary outcome was change in cognition, measured with the MDS-CPS (range 0-6, higher=more cognitive impairment). For all patients, functional and cognitive decline over time was analyzed using multivariable linear regression analyses. Subgroup analysis examined those with at least one hospitalization and MDS data before and after hospitalization for within-person pre/post-hospitalization changes in ADL and CPS scores without covariate adjustment.

Results: After exclusions, our analytic sample included 147 patients. Mean age was 82.9 years, 36.1% were male and 91.5% were Asian. Mean baseline ADL score was 18.2 (SD 5.4) and mean baseline CPS score was 2.9 (SD 1.4). Mean follow-up time was 1.5 years (SD 1.2). Linear regression adjusting for Charlson Comorbidity Index showed increased ADL disability (2.9 points, 95%CI(2.13, 3.78), p<0.001) after hospitalization, with slight decreased disability by the 2nd MDS after NH readmission (-2.01, 95%CI(-1.35, -2.67), p<0.001). CPS score worsened by 0.47 (95%CI(0.28, 0.65), p<0.001). On within-person comparisons, ADL disability increased by 4.5 points (95%CI(4.3,5.8), p<0.001) after
hospitalization, with slight decreased disability by the 2nd MDS assessment after NH readmission (-1.6, 95%CI(-3.2,-0.1), p=0.04). CPS score worsened by 0.7 points (95%CI(0.4,1.1), p<0.0001).

Conclusion: Hospitalization was significantly associated with increased functional decline among elderly NH patients, with slight improvement after readmission to the NH. Treatment of acute illness in the NH should be included as an option during goals of care discussions.

Key words: Aged, post-hospitalization functional decline, nursing home, cognitive decline.
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Chapter 1. Introduction

According to CMS reports, approximately 1.5 million individuals in the U.S. reside in a nursing home (NH), 88.3% are aged 65 years or older\(^1\). These patients often have impairments in the Activities of Daily Living (ADL) and multiple medical co-morbidities. Between 1984 and 1994, almost three quarters of all NH residents required help with 3-6 ADLs\(^2\). NH residents have a higher risk than their peers in the community for transfers to the emergency room for acute illness, with rates of hospital admission as high as 81% of all emergency room visits\(^3\). However, a number of studies suggest that hospitalization can lead to significant functional decline for elderly patients\(^4\). In community-dwelling elderly patients, hospital admission, regardless of diagnosis, is associated with short and long term disability\(^5\). The risk for post-hospitalization disability also increases with age\(^4\). This is important for elderly NH patients because functional decline is associated with decreased quality of life, falls, infections, pressure ulcers, and mortality\(^6,7\).

According to Medicare/Medicaid data, there is an increasing percentage of NH patients in Hawaii requiring assistance with 3-6 ADLs (79.8% in 2011 vs 80.6% in 2012)\(^8\). Compared with 2012 national MDS data, Hawaii also has a higher percentage of NH patients with disability in 3-6 ADLs (80.6% vs 68.2%)\(^8\). There are no studies to explain if worsening of post-hospitalization disability may be contributing to this trend. Our study examined the functional trajectories for a population of patients in a large (170-bed) hospital-affiliated NH in Honolulu, Hawaii, to determine whether hospitalizations predict functional decline in nursing home patients.
Chapter 2. Methods

Study Design

We conducted a longitudinal observational study of all patients admitted between 1/1/2003 and 12/31/2006 to a 170-bed hospital-affiliated NH in Honolulu, Hawaii. Data were collected from NH and hospital medical records, and the Minimum Data Set (MDS). Patients with total ADL dependence, severe cognitive impairment (Cognitive Performance Scale CPS≥6) at baseline or no MDS data before and after a hospitalization were excluded. Follow up was conducted from time of admission to the NH until death (data available up to 6/30/2011), discharge from the NH, or 2 years from the date of admission.

Study Setting and Population

The study setting was a 170-bed hospital-affiliated NH in Honolulu, Hawaii. This NH includes 25 beds for skilled nursing facility (rehab) and 145 beds for intermediate care facility (long term care). The adjacent hospital and NH share the same electronic medical records and paper records, allowing for thorough data collection. Transitions of care usually occur within this system, across several levels of care, which minimizes loss to follow up. The study population included all patients admitted to this NH over a period of 4 years, N=238. After exclusion of patients with total ADL dependence, severe cognitive impairment at baseline or missing MDS data before or after a hospitalization, a total of 147 patients were included in this analysis. The mean age on admission was 82.9 years old. Over 75% of the population was of Asian American or Pacific Islander ethnicity.

Data Collection

Our primary outcome was change in function, measured by the MDS-ADL long-form scale. Designed in response to the United States Congress in the Omnibus Budget Reconciliation Act of 1987, the minimum data set (MDS) is a comprehensive needs assessment tool that is used for federally mandated quarterly assessments of all NH patients. It has seven ADL items including bed mobility, transferring, locomotion, dressing, eating, toilet use and personal hygiene. For each ADL item, self-performance is scored from 0, indicating total independence to 4, indicating total dependence. The MDS-ADL score is a total of scores
for all seven ADLs with a range from 0-28, with higher scores representing greater disability\(^9\). This scale has been validated to detect clinically meaningful change in function (change of 1 point) over time\(^9\).

Our secondary outcome was change in cognition, measured with the MDS-Cognitive performance scale (MDS-CPS). The MDS-CPS scale is an algorithm that was designed to simplify the assessment of cognitive status using 5 variables from the MDS\(^10\). The 5 domains utilized are: mental status, cognitive skills for daily decision making, impairment count for memory, understandable communication, and dependence for eating\(^10\). This scale correlates with scores from the Mini-Mental State Examination (MMSE) and tests for severe impairment\(^10,11\). Cognitive performance ranges from a score of 0 (intact) to 6 (very severe impairment)\(^10\). The covariates that we examined were age (years), gender, number of hospitalizations, Charlson Comorbidity Index, and follow up time from admission. The Charlson Comorbidity Index calculates the one year mortality risk for a patient based on the number and severity of comorbidities they have. This index assigns a score from 1-6 for each diagnosis from 17 categories weighted by the risk for mortality from the individual disease. The sum of these scores are then modified with a correction for age\(^12,13\).

Institutional Review Board (IRB) approval was obtained from the study facility and the University of Hawaii. Informed consent was not required since the data were collected from medical chart reviews. Each study participant was identified by an assigned identification number, and all data were kept confidential. Data was stored in a secured cabinet and locked in an office.

**Sample Size and Power Calculations**

The null hypothesis is that hospitalization does not predict functional or cognitive decline in elderly nursing home patients. Sample size calculations were done using a two-sided t-test. For the primary outcome of change in MDS-ADL score, the standard deviation from previous studies was 4.4\(^14\). To detect a clinically meaningful effect size of 1 point, setting \(\alpha\) (two-sided) =0.05 and power= 0.80, \(n=253\). For the secondary outcome of change in CPS score, the standard deviation from previous studies was 1.9\(^10\). To detect a clinically meaningful effect size of 1 point, setting \(\alpha\) (two-sided) =0.05 and power= 0.80 using a
paired t-test, the required sample size is n=31. This does not account for patients who have multiple measurements of MDS-ADL scores and CPS scores over time, which may increase power.

**Statistical Analysis**

Statistical analysis was performed using SAS version 9.3 (SAS Institute, Inc., Cary, NC). The null and alternative hypothesis was defined prior to data analysis. For all patients, functional and cognitive decline over time was analyzed using multivariable linear regression analyses. For the between person model, we used mixed methods treating the repeated measurements as clustered within the individual patients. Subgroup analysis examined those with at least one hospitalization and MDS data before and after hospitalization. For within-person pre/post-hospitalization changes in ADL and CPS scores using SAS Proc GLM with an absorb statement to achieve the within person comparisons\textsuperscript{15}. 
Chapter 3. Results

After exclusions, our analytic sample included 147 patients (see Table 1). Mean age was 82.9 years, 36.1% were male and 91.5% were Asian. Mean baseline ADL score was 18.2 (SD 5.4) and mean baseline CPS score was 2.9 (SD 1.4). Mean follow-up time was 1.5 years (SD 1.2). Among this cohort 89 (63%) were hospitalized at some point during the study and 58 (35%) were not hospitalized. Between the groups of patients who were hospitalized and those who were not hospitalized during the study, the patients who were not hospitalized were older (mean age 86.3 vs 81.6). Otherwise, there were no other significant differences in baseline characteristics between the two groups.

Table 1. Study Population Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Hospitalized</th>
<th></th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (n=89)</td>
<td>No (n=58)</td>
<td></td>
</tr>
<tr>
<td>Mean ±SD or Percent</td>
<td>Mean ±SD or Percent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age in Decades</td>
<td>81.6 ± 10.8</td>
<td>86.3 ± 10.0</td>
<td>0.008</td>
</tr>
<tr>
<td>1st ADL score</td>
<td>15.8 ± 6.4</td>
<td>17.6 ± 5.9</td>
<td>0.09</td>
</tr>
<tr>
<td>1st CPS score</td>
<td>2.9 ± 1.4</td>
<td>2.8 ± 1.4</td>
<td>0.89</td>
</tr>
<tr>
<td>Charlson Comorbidity Index</td>
<td>4.5 ± 3.1</td>
<td>4.6 ± 3.8</td>
<td>0.85</td>
</tr>
<tr>
<td>Female</td>
<td>62.8%</td>
<td>37.3%</td>
<td>0.55</td>
</tr>
<tr>
<td>Male</td>
<td>58.0%</td>
<td>42.0%</td>
<td></td>
</tr>
</tbody>
</table>

Linear regression adjusting for Charlson Comorbidity Index showed a significant increase in ADL disability (2.9 points, 95%CI(2.13, 3.78), p<0.001) after hospitalization, with a slight improvement in function by the second MDS after NH readmission (-2.01, 95%CI(-1.35, -2.67), p<0.001)(See Table 2). Cognitive function worsened by a change in CPS score of 0.47 (95%CI(0.28,0.65), p<0.001) and also showed some improvement by the second MDS after NH readmission (See Table 3).
Table 2. Change in Post-Hospitalization ADL Score

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Change in ADL score</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st ADL score on return to NH vs. Pre-hospital</td>
<td>2.95</td>
<td>2.13-3.78</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>2nd ADL score on return to NH vs. Pre-hospital</td>
<td>0.94</td>
<td>0.19-1.7</td>
<td>0.01</td>
</tr>
<tr>
<td>2nd post vs 1st post</td>
<td>-2.01</td>
<td>-1.35,-2.67</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

*controlled for age, gender, number of hospitalizations, Charlson Comorbidity Index and follow up time from admission.

Table 3. Change in Post-Hospitalization CPS Score

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Change in CPS</th>
<th>95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st CPS score on return to NH vs. Pre-hospital</td>
<td>0.47</td>
<td>0.28, 0.65</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>2nd CPS score on return to NH vs. Pre-hospital</td>
<td>0.18</td>
<td>0.01, 0.35</td>
<td>0.04</td>
</tr>
<tr>
<td>2nd post vs 1st post</td>
<td>-0.29</td>
<td>-0.14, -0.44</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

*controlled for age, gender, number of hospitalizations, Charlson Comorbidity Index and follow up time from admission.
On comparing within-person for pre and post hospitalization function, ADL disability increased by 4.5 points (95%CI(4.3,5.8), p<0.001) after hospitalization, with some functional recovery by the 2nd MDS assessment after NH readmission (-1.6, 95%CI(-3.2,-0.1), p=0.04), (See Figure 1). Within-person comparison for pre and post hospitalization for cognition found that CPS score worsened by 0.7 points (95%CI(0.4,1.1), p<0.001, (See Figure 2).

Figure 1. Change in ADL Score (within person analysis)

Analysis from 25 random patients in our cohort who had ADL data before and after hospitalization. The mean change in ADL score is shown in bold.

Figure 2. Change in CPS Score (within person analysis)

Analysis from 25 random patients in our cohort who had CPS data before and after hospitalization. The mean change in Cognitive Performance Scale is shown in bold.
Chapter 4. Discussion

Our study found that hospitalization was associated with a significant increase in ADL scores for nursing home patients, indicating functional decline. In addition, nursing home patients who were hospitalized also had worsening cognitive performance scores compared with patients who were not hospitalized. By the second MDS measurement after hospitalization, there was a slight improvement in both functional status and cognition, but the overall trajectory for these patients remained worse than pre-hospitalization baseline.

Several studies have examined hospitalization as a risk factor for functional decline in NH patients with similar results. One study examining elderly long stay NH patients (cumulative stay of at least 90 days) in the U.S. grouped outcomes into trajectories that were stable, worsening, or improving\(^\text{16}\). They found that hospitalization was associated with high rates of worsening functional trajectories for patients who had mild to moderate ADL impairments at baseline (31.3-61.4\%)\(^\text{16}\). Another study that examined a cohort of 5,871 Medicare patients in the AHEAD study found hospitalization to be the strongest predictor of functional decline with a dose-response response effect; the more hospitalizations a patient had over the past year, the higher their likelihood of functional decline\(^\text{17}\). However, this study included both community-dwelling and NH patients.

There are a few studies that describe post-hospitalization functional decline in specific clinical situations, including the initiation of dialysis during hospitalization, surgery for colon cancer, and lower respiratory infection\(^\text{18-20}\). Although hospital diagnosis was not included in our analysis, a future direction could include a comparison of post-hospitalization functional status in a similar cohort by hospital diagnosis.

Some studies describe an improvement in functional status after hospitalization. Among long-stay NH patients, the patients most likely to have functional improvement post hospitalization were patients with hip fracture\(^\text{16}\). Another study of short-stay NH patients (100 days or less) found more than 60% of the cohort to have improvement in ADL scores after discharge from the hospital, though analysis did not include baseline function prior to hospitalization\(^\text{21}\). The improvement in function and cognition seen in our study between the first and second MDS measurement post-hospitalization may be describing a similar phenomenon, since our cohort included both short and long-stay NH patients.
An important risk factor that contributes to both functional and cognitive decline after hospitalization is delirium. Delirium is well described as a risk factor for functional and cognitive decline in short and long-term follow-up after hospitalization\textsuperscript{22-24}. Many NH patients have multiple risk factors for delirium at baseline, including a high burden of chronic disease, dementia, older age, and ADL disability. Another future direction could examine the long term effects of delirium on the post-hospitalization cognitive and functional status of NH patients.

\textbf{Strengths and Limitations}

Some of the strengths of our study include a minimal loss to follow-up. In addition, most patients moved within the same healthcare system including a hospital, rehab/skilled nursing and long-term care facility, with the same medical records, which allowed for collection of complete follow-up data. Considering the unique ethnic makeup of our cohort, generalizability of this study to non-Asian or Pacific Islander populations is limited. This may also be considered a strength since Asian and Pacific Islander groups are under-represented in other NH studies. Another limitation of our study was the lack of ICD-9 diagnoses for hospitalizations since we utilized data from a previously collected database.
Conclusion

Hospitalization involves several potential hazards for elderly patients which may have a long-term adverse effect on function. Our study found that hospitalization was significantly associated with both functional and cognitive decline for elderly NH patients. For the treatment of acute illness in a NH patient, careful consideration should be given to the risks and benefits of treatment in the NH versus hospitalization. An important part of this discussion should include an open dialog with patients and families about goals of care since maintenance of functional status and cognition are important for quality of life.
Bibliography


