Factors Predicting Rehospitalization of Elderly Patients in a Postacute Skilled Nursing Facility Rehabilitation Program

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Objective: To examine potential risk factors for rehospitalization of skilled nursing facility (SNF) rehabilitation patients.

Design: Retrospective review of rehabilitation charts.

Setting: SNF rehabilitation beds (n=114) at a 514-bed urban, academic nursing home that receives patients from tertiary care hospitals.

Participants: Consecutive rehabilitation patients (n=50) who were rehospitalized during days 4 to 30 of rehabilitation, compared with a matched group of rehabilitation patients (n=50) who were discharged without rehospitalization.

Interventions: Not applicable.

Main Outcome Measure: Data on potential risk factors were collected: demographics, medical history, conditions associated with preceding hospitalization, and initial rehabilitation examination and laboratory values. The clinical conditions precipitating rehospitalizations were noted.

Results: Sixty-two percent of rehospitalizations were related to complications or recurrence of the same medical condition that was treated during the preceding hospitalization. The rehospitalized group had significantly more comorbidities including anemia (P<.001) and malignant solid tumors (P<.001), index hospitalizations involving a gastrointestinal condition (P<.001), needed more assistance with eating (P<.001) and walking (P<.001), and had lower hemoglobin (P<.002) and albumin levels (P<.001). A logistic regression model found that the strongest predictors for rehospitalization are a history of a malignant solid tumor (odds ratio [OR]=10.10), a recent hospitalization involving gastrointestinal conditions (OR=4.62), and a low serum albumin level (with each unit decrease in albumin, the odds of rehospitalization are 4 times greater [OR=.24, P=.005]).

Conclusions: Comorbid conditions, reasons for index hospitalization, and laboratory values are associated with an increased risk for rehospitalization. Further studies are needed to identify high-risk elderly patients and target interventions to minimize rehospitalizations.

Key Words: Delivery of health care; Episodes of care; Hospital readmissions; Rehabilitation; Rehabilitation outcome; Subacute care.
a gastrostomy tube, a serum creatinine level greater than 3.0 mg/dL, and a low serum albumin level.

One of the most troubling findings from several studies of adults older than 70 years is that those with declines in ADL function during their initial hospitalization were more likely to be rehospitalized or die within a few months. Since most patients use SNF rehabilitation because of worsened function during acute hospitalization, it suggests that the SNF rehabilitation population is at an even greater risk of rehospitalization compared with other discharged patients.

The purpose of this study was to examine postacute SNF rehabilitation patients to identify patient-specific risk factors for rehospitalization.

METHODS

Setting and Participants

The study was conducted at an urban, academically affiliated nursing home. Of the nursing home’s 514 beds, 114 beds are dedicated to postacute skilled rehabilitation (SNF) and are staffed by full-time physiatrists, geriatricians, nurse practitioners, nurses, physical therapists, and occupational therapists. The facility also had an on-site physician 24 hours a day to evaluate patients on nights and weekends, and the staff was able to provide antibiotics and intravenous fluids on-site. The research protocol was approved by, and a waiver of consent obtained from, the institutional review board.

The sample included individuals older than 65 years who were admitted from an acute hospital to the postacute rehabilitation units of the SNF from May 2009 to October 2009. The first 50 consecutive SNF patients who were rehospitalized during days 4 to 30 of SNF rehabilitation were compared with a group of 50 SNF patients who were discharged without being rehospitalized. The comparison group was selected by matching age, sex, and SNF admission date of the rehospitalized subjects.

Emergency department visits were not counted as a rehospitalization. Individuals rehospitalized within 1 to 3 days of their SNF admission were excluded because of anticipated lack of sufficient data: patients admitted on Friday and weekends did not have laboratory bloodwork obtained until Monday. Individuals rehospitalized after 30 days were excluded because the national average number of Medicare-covered days per SNF rehabilitation stay is 26.7 days, and many other published studies use a 30-day time frame. Furthermore, individuals with a documented “do not hospitalize” order were excluded from the study.

Measurements

SNF medical charts were retrospectively reviewed to collect data on potential risk factors identified in the literature summarized in the background above, including demographics, conditions associated with the preceding hospitalization, and a history of medical conditions comprising the Charlson Comorbidity Index, as measured by the Charlson Comorbidity Index (CI), level of physical function (as measured by the BI), level of mobility, feeding function, and number of pressure ulcers, as well as albumin, hemoglobin, and creatinine levels. Before computing the test for independent means, homogeneity of variance was tested using the Levene’s test for equality of variances. If the variances between 2 comparison groups were found to be unequal, the degrees of freedom were adjusted appropriately.

RESULTS

Demographic Characteristics

There were no significant differences between the rehospitalized and the discharged group in terms of age (81.3 vs 81.30y: range, 66–101y; t_(50) = -0.2, P = 0.981), sex (χ² = 0.0, P = 1.00), race (χ² = 0.9, P = 0.829), education (χ² = 2.5, P = 0.485), or subjects’ prior residence (χ² = 5.4, P = 0.068). In the group as a whole, more than half (52%) of the subjects were white, while 26% were black or African American, 19% were Hispanic or Latino, and 3% were Asian. Many (44%) attended college or technical school, 38% attended high school, and 16% had up to an eighth grade education. In each group, about half lived alone and half lived with family before hospitalization.

Reasons for Rehospitalization

In the rehospitalized group, the most frequent reasons for rehospitalization were unstable vital signs (38%), change in mental status (30%), pneumonia or other infections (26%), pain (20%), respiratory distress (18%), and abnormal laboratory results (18%) (table 1). Of note, 62% of rehospitalizations appeared to be for complications, recurrence, and/or continuation of the same condition treated during the hospitalization that preceded SNF rehabilitation. For example, of 11 subjects who had hip surgery, 7 were rehospitalized because of deep vein thrombosis, loose screws, hip dislocation, or bleeding surgical site. Several subjects who were initially hospitalized for respiratory failure, myocardial infarction, or abdominal surgery were rehospitalized because of respiratory distress, chest pain, or vomiting, respectively. Other subjects had recurrent seizure, stroke, heart failure, gastrointestinal bleeding, or cancer-related intestinal obstruction.

Comparison With Subjects Who Were Not Rehospitalized

There were significant differences between the subjects who were rehospitalized and those who were successfully discharged home. Those who were rehospitalized were more likely to have a gastrointestinal condition (eg, endoscopy, abdominal surgery, Clostridium difficile colitis) associated with their hospitalization before rehabilitation (χ² = 10.2, P = 0.001).
Furthermore, those who were rehospitalized were more likely to have a history of a malignant solid tumor ($\chi^2 = 12.4$, $P < .001$) and a history of anemia ($\chi^2 = 10.9$, $P = .001$). There were no significant differences in the number of rehospitalized and discharged subjects in terms of a history of pulmonary disease, renal disease, CHF, or recent hospitalization for CHF exacerbation or orthopedic surgery (table 2).

Rehospitalized subjects also significantly differed from discharged subjects in terms of comorbidities, level of physical function, number of pressure ulcers, and laboratory values (table 3). Those who were rehospitalized had higher Charlson Comorbidity Index scores (3.9 vs 2.0, $t_{88} = -3.6$, $P = .001$) and lower levels of physical functioning assessed during initial rehabilitation admission (BI: 28.4 vs 35.9, $t_{88} = -2.2$, $P = .03$), including assistance needed with feeding ($5.2$ vs $6.7$, $t_{88} = -3.2$, $P = .002$) and mobility ($1.6$ vs $3.6$, $t_{88} = -2.2$, $P = .03$). The rehospitalized group also had significantly more pressure ulcers ($0.9$ vs $0.3$, $t_{88} = -2.0$, $P = .05$), a lower hemoglobin level ($10.3$ vs $11.4$g/dL, $t_{88} = 3.2$, $P = .002$), and a lower albumin level ($2.9$ vs $3.4$g/dL, $t_{88} = 4.1$, $P < .001$) than those who were successfully discharged home. The 2 groups did not significantly differ in creatinine levels (see table 3).

### Predictors of Risk for Rehospitalization

The following variables were entered into the logistic regression analysis: Charlson Comorbidity Index scores, history of a malignant solid tumor, whether prior hospitalization involved a gastrointestinal condition, ability to feed self, and albumin and hemoglobin levels. A history of anemia was not entered into the model because it had high colinearity with hemoglobin levels ($r = -.83$, $P < .001$). Hemoglobin was chosen for the regression analysis because it had a slightly stronger relationship to being rehospitalized ($r = .34$, $P = .001$).

The results of the regression analysis indicate that a history of a malignant solid tumor, recent hospitalization involving gastrointestinal conditions, and low albumin levels appeared to be the strongest predictors for rehospitalization. The model significantly predicted rehospitalization and correctly classified 74% of the subjects ($\chi^2 = 28.0$, $P < .001$). The model also exhibited specificity (proportion correctly identified as not being rehospitalized) and sensitivity (proportion correctly identified as being rehospitalized) of 79% and 70%, respectively. Within the model, it was found that those with a history of solid tumor have 10 times greater odds of rehospitalization (odds ratio $[OR] = 10.10$, $P = .038$), and those with a recent hospitalization involving gastrointestinal conditions have 4 times greater odds of rehospitalization (OR = 4.62, $P = .022$). Finally, with each unit decrease in albumin, the odds of rehospitalization is 4 times greater ($OR = .24$, $P = .005$).

## DISCUSSION

Rehospitalizations are distressing to all parties; patients suffer disruptions in their usual routines and physically decline, families worry and miss work, health care providers may feel inadequate in their ability to heal, and payers lament the costs.

Our study supports previous studies of rehospitalization risk factors and contributes new knowledge about SNF rehabilitation patients specifically. In non-SNF patients, a low serum albumin level is a known predictor of rehospitalization, death, and other adverse outcomes. Our study confirms that a low albumin level is predictive of rehospitalization in SNF rehabilitation patients.

Consistent with studies in other settings, we found that multiple comorbidities and a high Charlson Comorbidity Index...
is associated with rehospitalization of SNF rehabilitation patients. In a subgroup analysis of our subjects with solid cancers (not leukemia nor lymphoma), metastatic malignant disease was specifically associated with rehospitalization, while non-metastatic malignant disease was not significantly associated.

A novel finding of our study is the association of rehospitalizations with preceding hospitalization involving gastrointestinal conditions. Subgroup analysis also shows a trend toward significance for each of the subcategories, including nonsurgical endoscopic gastrointestinal procedures, abdominal surgery, and Clostridium difficile infection.

We observed that poor overall ADL function and an inability to eat unassisted are associated with rehospitalization of SNF patients. This is consistent with numerous other studies showing that these are risk factors for rehospitalization and death in the general population, in rehabilitation patients,\(^36\) and in nursing home residents. A more sensitive measure than the BI components is needed to evaluate whether differences in mobility impairment are predictive of rehospitalization, because most SNF rehabilitation subjects in both groups were unable to walk on SNF admission (unable, 0 points; mean, 1.6 vs 3.6); very few SNF rehabilitation subjects fit the other Barthel mobility categories (ie, propel own wheelchair >50yd (>45.7m), 5 points; walk >50yd (>45.7m) with help, 10 points; walk independently, 15 points). Perhaps if the subjects were scored based on the ability to stand, walk 2 steps, walk 1 yard (.914m), walk 10 yards (9.14m), or walk >10 yards (>9.14m), this more sensitive categorization of subjects might show a level of functional debility that is predictive of rehospitalization.

Pressure ulcers are clinically associated with immobility and low serum albumin levels. Prior studies showed that pressure ulcers are associated with rehabilitation patients who are less likely to be discharged to the community and with nursing home long-term care residents who are more likely to be hospitalized. Not surprisingly, our rehospitalized group had more pressure ulcers on initial SNF assessment than our discharged group. While most patients in both groups did not have any ulcers on arrival to the SNF (72% vs 80%), the rehospitalized individuals with ulcers had both more ulcers (3.1 vs 1.3) and a higher stage of ulcers (2.6 vs 1.9; stage range, 1–4) than the discharged patients with ulcers.

The most common reasons for rehospitalization of our subjects included conditions identified in previous studies: pulmonary disease, renal failure, CHF exacerbation, pneumonia, and other infections.\(^{9,47,51,52}\) However, an alarming finding in our study is that two thirds of our SNF rehabilitation subjects were sent back to the hospital with a surgical complication or recurrence of the same medical condition as the preceding hospitalization. Possible explanations may include that SNF rehabilitation patients are sicker overall than other populations, some chronic conditions are relapsing by nature, and/or patients were inappropriately discharged early from the hospital before they were medically stable. Regardless of the cause, these patients present challenges to episodic bundling payment policies, which for example would involve Medicare or health insurance companies only paying hospitals one set payment to cover all services provided during the patient’s initial health event and the 30 days after hospital discharge.

**Implications**

In light of the paucity of highly sensitive and specific rehospitalization predictive models focusing on SNF rehabilitation patients, our predictive model with a sensitivity and specificity of 70% and 79%, respectively, is a clinically meaningful tool to identify patients to target for enhanced care. Compared with standard care, no additional harm would be done to patients who were not identified by this model. This study’s results provide a basis for future larger studies to develop strategies to better predict and prevent rehospitalizations.

By identifying patients with high risk for rehospitalization, care interventions can be targeted at them during hospitalization and postacute care to decrease the risk of future rehospitalization. Hospital discharge planning can take into account rehospitalization risk factors to consider timing and site of care that might be most appropriate.\(^{51,53,54}\) While currently there is not enough evidence to choose one site over another,\(^54\) research is needed regarding whether it would be best for high-risk patients to receive care in a traditional postacute care setting (home or SNF), extended care settings such as inpatient rehabilitation or transitional care units, innovative hospital-at-home programs, prolonged hospitalization, or hospice care.\(^55\)

Postacute care providers can use the prognostic factors from this and future related studies to develop admission screening tools and clinical protocols to identify and monitor their highest risk patients. For example, Ouslander et al\(^56\) developed a nursing home quality improvement tool to assist staff in assessing changes in patient status to reduce hospital admissions. Furthermore, hospital and postacute care providers can coordinate information exchange to improve transitions of care.

Given the progressively debilitating nature of many diseases, hospitalizations often do not result in cure. The medical field has increasingly recognized the value of palliative care even for
patients who are not terminally ill. A palliative care approach emphasizes understanding each patient’s perspective of his/her own illness, alleviating symptoms, providing emotional support for patients and families, and discussing the benefits and burdens of treatment options, including hospitalizations.42,57

Besides point-of-care medical decisions for individual patients, rehospitalization risk data can inform population management, payment, and other policies that support models of care such as high-intensity care in nonhospital settings, risk-adjusted reimbursement, and shared accountability of patient outcomes.59-61 Beyond identifying risk factors for rehospitalization, more research is needed to understand which risk factors are modifiable and which models of care effectively reduce hospitalization. But the success of such policies and new models of care will depend on adequately training and reimbursing a health care workforce to provide the care.

Study Limitations

There are several limitations of this study because data were retrospectively collected from available handwritten notes in the SNF chart. There may be rehospitalization risk factors we measured that did not reach statistical significance in our study because of the small sample size. SNF patients who were rehospitalized within 3 days were excluded because of incomplete chart data, although those are likely the highest risk patients. There may also be unmeasured confounding factors such as psychosocial and financial pressures to transfer patients from an SNF to the hospital.61 An electronic medical record and regional health information exchange would facilitate studying a larger sample size and provide a more comprehensive view of each patient’s medical history and health care utilization.

Our participants may be sicker than patients in other SNFs because this study was conducted at a large urban, academic SNF that receives patients from several tertiary care hospitals. Of 100 possible points on the Barthel Index (BI), our rehospitalized and comparison groups had scores of 28 and 36, respectively, which are below the key score of 40 representing complete ADL dependence.50 Furthermore, our subjects may be sicker because this SNF had intravenous infusion therapy and a physician on-site 24 hours a day to evaluate and treat less severe abnormalities at the SNF without sending those patients to the hospital. Prior studies identified that lack of on-site clinicians and intravenous fluids is associated with potentially avoidable hospitalizations.59-60 Our study is valuable in characterizing the truly highest risk patients: elderly patients hospitalized at tertiary care hospitals with resulting severe ADL decline, who are subsequently discharged to an SNF but could not be treated at an SNF despite 24-hour physician coverage.

CONCLUSIONS

A history of a malignant solid tumor, a recent hospitalization involving gastrointestinal conditions, and a low serum albumin level are predictors of rehospitalization of elderly patients in SNF rehabilitation. SNF rehabilitation patients are often rehospitalized for reasons related to the preceding hospitalization. Additional studies are needed to identify targeted interventions to benefit patients with high-risk conditions to decrease rehospitalizations.

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References


