Cognitive Screening Predicts Magnitude of Functional Recovery From Admission to 3 Months After Discharge in Hospitalized Elders

Laura P. Sands,1,2 Kristine Yaffe,3,4,6,7 Kenneth Covinsky,1,2,7 Mary-Margaret Chren,5,7 Steven Counsell,8 Robert Palmer,9 Richard Fortinsky,10 and C. Seth Landefeld1,2,6,7

1UCSF/Mt. Zion Center on Aging and Departments of 2Medicine, 3Psychiatry, 4Neurology, 5Dermatology, and 6Epidemiology and Biostatistics, University of California, San Francisco. 7Veterans Affairs Medical Center, San Francisco. 8Division of General Internal Medicine and Geriatrics, Indiana University School of Medicine, Indianapolis. 9Division of Geriatrics, Cleveland Clinic Foundation, Ohio. 10Center on Aging and Division of Geriatrics, University of Connecticut Health Center, Farmington.

Background. Many older adults lose functional ability during the course of acute illness and fail to recover function. We sought to determine whether performance on a cognitive screen at the time of hospital admission predicted the magnitude of functional recovery after hospitalization.

Methods. We studied 2557 patients from two teaching hospitals to examine the association between level of impaired performance on a cognitive status screen and maintenance and recovery of functioning from admission through 90 days after discharge. On admission, 14% had mildly impaired cognitive performance with three or four errors on the Short Portable Mental Status Questionnaire; 28% had moderate to severely impaired cognitive performance with five or more errors on the cognitive status screen or inability to complete the screen and a diagnosis of dementia.

Results. Performance on a brief cognitive screen on admission was strongly related to subsequent change in function. Among patients who needed help performing one or more activities of daily living at the time of admission, 23% of patients with moderate to severely impaired cognitive performance, 49% of patients with mildly impaired cognitive performance, and 67% of patients with little to no impairment in cognitive performance recovered ability to independently execute an additional activity of daily living by discharge (p < .001). Similar relationships were seen for change in instrumental activities of daily living and mobility. In multivariate repeated measures analyses of basic and instrumental activities of daily living and mobility on admission, discharge, and 30 and 90 days after discharge, patients with mildly impaired cognitive performance on admission showed less improvement than patients who did not have impaired cognitive performance, but more than those with moderate to severely impaired cognitive performance. The pattern of results did not change when patients with any signs of delirium were excluded. Patients with impaired cognitive performance were more likely to be admitted to a nursing home for the first time by 90 days after discharge. The odds ratios were 2.8 (95% confidence interval = 1.8–4.5) for patients with mildly impaired cognitive performance and 6.7 (95% confidence interval = 4.5–9.8) for patients with moderate to severely impaired cognitive performance.

Conclusion. Cognitive screening at hospital admission can be used to stratify patients according to the magnitude of expected functional recovery after an acute illness that required hospitalization.

OLDER adults often lose functional independence during the course of acute illness and hospitalization, worsening their quality of life and leading to long-term disability, institutionalization, and death (1–5). This loss of functional independence has two stages—an initial decline often occurring before hospitalization, and subsequent failure to maintain or improve function during and after hospitalization (6–8). While the initial decline in function is often attributable to the acute illness, the reasons older persons subsequently fail to maintain or improve their functional performance after hospital admission have not been fully elucidated. Cognitive impairment, which is common in hospitalized elders (9), has been associated with functional change during the course of acute illness and hospitalization (6,10–14). It is not known from these studies whether cognitive impairment was associated with loss in functioning that occurred before admission, when most hospital-associated functional decline occurs (7), or with failure to maintain or recover functioning after hospital admission—a time when it is most feasible to implement interventions to prevent further functional decline and promote functional recovery.

Cognitive screening instruments provide a reliable, sensitive method for quickly determining whether a patient has cognitive impairment at admission (15). Prior studies have used cognitive status screens to demonstrate a relationship between cognitive impairment at admission and change from prehospitalization levels of functioning. However, it is unclear from these studies whether the predictive association was due to scores that reflected severe cognitive impairment or was present for all levels of cognitive impairment (11,16). Specifically, it is not known whether mildly impaired performance on a cognitive status screen at admission is associated with impaired recovery of functioning after admission.
In this study we hypothesized that patterns of functional recovery after admission for an acute illness differ for patients with moderate to severe, mild, and no cognitive impairment at admission as determined by performance on a cognitive status screen. We conducted secondary data analyses from a study of 2557 people age 70 years or older who were hospitalized for acute medical illness. Their cognitive status was assessed on admission and their ability to perform basic and instrumental activities of daily living and their mobility were determined at admission, discharge, and 30 and 90 days after discharge. We sought evidence of a direct relationship between the magnitude of impaired cognitive performance on admission and the frequency, the timing, and the degree to which patients lost, maintained, or improved functioning after admission.

**Methods**

**Subjects**

We studied patients aged 70 or older who were enrolled in two trials of an intervention to improve functional outcomes after hospitalization. Patients were admitted to University Hospitals of Cleveland (n = 1632) and Akron City Hospital in Ohio (n = 1531) for acute medical care from 1993 to 1997. Patients with a length of stay shorter than 2 days, postoperative surgical patients, and patients admitted to subspecialty medical teams (e.g., telemetry or cancer chemotherapy service) or intensive care units were excluded. The data for this study were collected for a second trial of an intervention that sought to improve functional outcomes in hospitalized elders by modifying the hospital environment, incorporating patient-centered care, providing discharge planning, and instituting medical care review (17).

To maximize the sample size in each analysis, we combined patients in the treatment and control groups because preliminary analyses revealed that there were no significant differences between the intervention and control groups in rates of recovery in activities of daily living (ADL), instrumental ADL (IADL), and mobility functioning through 3 months after discharge. A prior study that was restricted to patients from Akron City Hospital also confirmed that the intervention did not affect ADL, IADL, and mobility functioning through 3 months after discharge (18).

**Data Collection and Measurements**

Interviews were conducted in person by trained research staff on admission and discharge, and by telephone at 30 and 90 days after discharge.

Cognitive impairment was assessed on admission by administration of the 10-item Short Portable Mental Status Questionnaire (SPMSQ) (19). Some patients were too cognitively impaired to complete the SPMSQ. In addition, patients’ charts were reviewed for a diagnosis of dementia. Higher scores on the SPMSQ reflect greater impairment in cognitive performance. With the use of published norms (19), patients were categorized into three groups: none to little impairment in performance (two or fewer errors on the SPMSQ), mildly impaired performance (three or four errors on the cognitive status questionnaire), and moderate to severely impaired performance (five or more errors on the SPMSQ or inability to complete the SPMSQ and a chart diagnosis of dementia).

Three domains of function were assessed at each interview: ADL, IADL, and mobility. On admission we also inquired about patients’ functioning 2 weeks before admission. We measured five ADL: bathing, dressing, toileting, transferring from a bed to a chair, and eating (20). The IADL were shopping, cooking, performing household chores, using transportation, managing money, managing medications, and using the telephone (21). We inquired about mobility with five hierarchically arranged items: ability to walk to a table, walk inside the house, walk a block, walk uphill or upstairs, and run a short distance.

Patients were considered independent in an activity if they could do it without the assistance of another person. Scores for each of these scales were computed as the total number of tasks patients could perform independently. Surrogates reported on patients’ level of functioning when patients were too ill to be interviewed or had moderate to severe cognitive impairment. On admission, surrogates reported for 0.2% of patients with no cognitive impairment, 0.6% of patients with mild cognitive impairment, and for 70% of patients with moderate to severe cognitive impairment.

Through chart review we determined the reason for hospitalization, illness severity as assessed by the Acute Physiology Score (APACHE II) (22), and number and severity of comorbid illnesses by use of the Charlson comorbidity scale (23). Patients not admitted from a nursing home who entered one after hospitalization were considered to have a new nursing home placement. At the time of the admission interview, research assistants rated patients for three signs of delirium: fluctuating inattention, disorganized thinking, and altered level of consciousness. Patients with none of these three signs were classified as not having signs of delirium. Patients with one or more of these three signs may have been experiencing symptoms of delirium (24,25).

**Analytic Methods**

The analytic sample consisted of the 2557 patients with cognitive status data from admission; 606 other patients were excluded because they were not interviewed with the cognitive status questionnaire and did not have a chart diagnosis of dementia (n = 575) or their charts were not reviewed (n = 31). The excluded patients had values between mild cognitive impairment and moderate to severe impairment on several admission characteristics (age, APACHE II, Charlson comorbidity score, and baseline ADL score).

We report results for two main dependent variables for each domain of function: change from admission to discharge, and change from admission to 90 days after discharge. Results from the bivariate analyses of change in functioning from admission to 30 days after discharge were similar to those reported for change from admission to 90 days after discharge, so they are not reported. For bivariate analyses, change was classified as improved, unchanged, or worse.

First, we tested for differences among the three cognitive groups in rates of change on each functional measure by using the Mantel–Haenszel test for trend. These bivariate
analyses were conducted separately for patients who were and were not independent on admission, because patients who were independent had the highest possible score on the scale, which prevented measurement of improvement in this group. Similarly, patients who were completely dependent in functioning had the lowest possible score on the scale, which prevented measurement of decline in this group. These artifacts of measurement could confound the relationship between cognitive status performance at admission and the magnitude of change in ADL, IADL, and mobility.

Second, we tested the association between performance on the cognitive status screen at admission and recovery of functioning after admission, using multivariate repeated measures analyses of covariance that controlled for age, acute physiology score, Charlson comorbidity score, assignment to the intervention or usual care, and baseline level of functioning. The dependent variables in these analyses were functioning scores from admission, discharge, and 30 and 90 days postdischarge. We tested for a significant time by group interaction to determine whether the three cognitive groups differed in their degree and rate of change in functioning over time. Post hoc tests determined the intervals during which the groups significantly improved. Although the purpose of the analyses was to determine whether a brief cognitive screen on admission was predictive of functional outcomes after admission, it was important to assess whether the results could be attributed to cognitive impairment caused by acute confusion or delirium. Therefore, we reran the results, excluding patients with any of the signs of delirium that were assessed on admission.

Finally, we examined whether performance on a cognitive status screen at admission was associated with new admission to a nursing home. We used logistic regression analysis and controlled for age, APACHE II score, Charlson comorbidity score, assignment to treatment or usual care, and baseline level of functioning.

Results

The mean age of the patients was 80 years, and 65% were women; on admission, 14% had mildly impaired cognitive performance and 28% had moderate to severely impaired cognitive performance. In many ways, patients with moderate to severely impaired cognitive performance on admission differed from those with little or no impairment in cognitive performance (Table 1). They were older, more likely to be female, and had worse admission functional status as measured by independence in ADL, IADL, and mobility. Greater cognitive impairment was associated with greater illness severity and greater number and severity of comorbid illnesses (p < .001). Post hoc analyses revealed that each cognitive group significantly differed from the others in illness severity (p < .001).

Cognitive Status on Admission and Function After Admission for Patients Who Were Independent or Dependent in Functioning

There were significant differences among the three cognitive groups in rates of change between admission and discharge (Figure 1). Among patients who were independent in all tasks within a domain on admission, more than twice as many patients with impaired cognitive performance on admission declined in their ability to independently execute ADL, compared with patients with little or no impairment in cognitive performance (Figure 1A). Half of the patients with impaired cognitive performance declined in their ability to independently execute IADL, compared with 32% of the patients with little or no impairment in cognitive performance (Figure 1B).

Among patients who were dependent in one or more tasks within a domain on admission, the frequency of improvement in ADL from admission to discharge was greatest for patients with little or no impairment in cognitive performance. More patients with mildly impaired cognitive performance improved their ADL functioning than those with moderate to severely impaired performance (Figure 1D). Findings were similar for IADL (Figure 1E) and mobility (Figure 1F). In analyses restricted to patients who declined between baseline and admission, findings were similar.

Change in function from admission to 90 days after discharge significantly differed among the three cognitive groups (Figure 2). Among patients who were independent in all tasks within a domain on admission, decline in ADL occurred for only 14% of patients with little to no impairment in cognitive performance on admission, compared with 28% of patients with mildly impaired cognitive performance and 51% of patients with moderate to severely impaired cognitive performance (Figure 2A). More than half of the patients with impaired cognitive performance lost ability to independently execute IADL (Figure 1B).

Among patients who were not independent in all tasks within a domain on admission, 73% of the patients with little to no impairment in cognitive performance improved their ADL functioning by 90 days after discharge compared with 62% of patients with mildly impaired cognitive performance and 35% of patients with moderate to severely impaired cognitive performance (Figure 2D). Similar patterns were seen for IADL and mobility (Figures 2E and 2F).

Cognitive Status on Admission and the Timing and Magnitude of Change in Functioning

Patients with different degrees of impaired cognitive performance on admission experienced different rates of change (p = .006) in their ability to independently execute ADL from admission to 90 days after discharge (Figure 3). Patients with little to no impairment in cognitive performance significantly improved their ability to independently execute ADL from admission to discharge (p < .001). Patients with mildly impaired cognitive performance improved in their activities of daily living over two intervals: admission to discharge (p < .05), and discharge to 30 days (p < .05). ADL functioning did not significantly improve after admission for patients with moderate to severely impaired cognitive performance.

Patients with different levels of impaired cognitive performance on admission also differed in their rate of change (p < .001) in their ability to independently execute IADL (Figure 3, middle panel). Patients with little to no impairment in cognitive performance made significant gains.
in IADL function (p < .05) during each interval between admission and 90 days after discharge, whereas the patients with mildly impaired cognitive performance improved significantly from admission to discharge (p = .006), but not thereafter. The patients with moderate to severely impaired cognitive performance did not significantly improve their level of IADL functioning after admission.

Similarly, patients with different levels of cognitive impairment on admission differed in their rate of change in mobility from admission to 90 days after discharge (p = .01).
All three groups experienced significant gains in mobility function ($p < .05$) through 30 days, but the magnitude of change was greater in patients with little to no impairment in cognitive performance on admission, compared with patients with mild to severely impaired cognitive performance ($p < .001$). The patients with mildly impaired cognitive performance gained more mobility function by discharge ($p = .037$) than patients with severely impaired cognitive performance.

To determine whether the results were due to the presence of delirium, we excluded all patients with any signs of delirium. Results were similar to the total analytic sample, with the three groups significantly differing in their rates and magnitude of change in their ability to independently perform ADL ($n = 1350; p = .028$), IADL ($p < .001$), and mobility ($p = .08$).

**Cognitive Status at Admission and Nursing Home Placement**

Table 2 reveals that patients with cognitive impairment were more likely to live in a nursing home for the first time after discharge. Thirteen percent of patients with mildly impaired cognitive performance and 29% of patients with moderate to severely impaired cognitive performance at admission were newly admitted to nursing homes after discharge, compared with only 7.5% of patients with little or no cognitive impairment at admission. By 90 days after discharge, the odds of newly being placed in a nursing home were 2.80 (95% confidence interval = 1.75–4.46) for patients with mildly impaired cognitive performance and 6.67 (95% confidence interval = 4.52–6.67) for patients with moderate to severely impaired cognitive performance, compared with patients with little to no cognitive impairment.
DISCUSSION

In 2557 acutely ill older patients admitted to the hospital, greater impairment on a cognitive status screen at admission was associated with poorer recovery of functioning after admission. Moreover, the greater the impairment on the cognitive status screen at admission, the greater the likelihood that patients would be newly admitted to a nursing home after admission.

There are two findings from this study that, to our knowledge, are novel. First, we demonstrated that impaired cognitive performance was associated with impaired recovery of functioning in three domains from admission through 90 days after discharge. Past studies have shown that cognitive impairment on admission is associated with functional change from 2 to 12 weeks before admission to discharge or thereafter (6,10,11,13,14). Because most of hospital-associated decline in functioning occurs before admission, it is difficult to know whether the significant association was attributable to functional loss that occurred before admission, or to failure to maintain or recover function during and after hospitalization. This distinction is important because interventions to forestall and restore lost functioning are most feasibly implemented after, rather than before, admission to the hospital. We show that greater impairment in cognitive performance on admission is associated with poorer recovery of functioning after admission. Although some hospital-based interventions have positively affected ADL functioning after admission (17,26), they were not focused on addressing functional recovery in cognitively impaired patients. It is critical that programs be designed that specifically address cognitively impaired patients’ vulnerability for losing and not recovering functioning after hospitalization for an acute illness.

Figure 2. Change in functioning from admission to 90 days. Better = improved score (compared with admission, patient could perform one or more activities without help); same = no change; worse = lower score (compared with admission, patient was unable to do one or more activities); n = sample size for each cognitive group; independent = could do the activities without help. At admission, none = little to no impairment in, mild = mildly impaired, and severe = moderate to severely impaired cognitive performance. The p value refers to the results of a chi-square test of independence.
The second novel finding from this study is that the relationship between performance on a cognitive status screen at admission and functional recovery thereafter was ordered: patients with mildly impaired cognitive performance recovered significantly less than those with little to no impairment in cognitive performance on admission, but significantly more than those with moderate to severely impaired cognitive performance. Prior studies (6,10,11,13,14,16) included delirium, dementia, or both, or a cognitive status score in models predicting recovery to baseline functioning. This approach does not elucidate whether the significant association was due to a subgroup of patients (e.g., only those with severe cognitive impairment). For example, the Hospital Admission Risk Profile (HARP) included cognitive status at admission as an important predictor of functional decline following acute medical illness and hospitalization (11), but cognitive status was designated as either severe impairment (an abbreviated Mini-Mental State Examination score of 0–14) or not severe. We show that increasingly greater cognitive impairment on admission is associated with increasingly poorer functional outcomes. Demonstration of an ordered relationship underscores the importance of conducting a cognitive status screen on admission to detect all levels of cognitive impairment to better predict patients’ functional outcomes after admission.

Our conclusion that the magnitude of functional recovery after hospital admission is associated with level of impairment on a cognitive status screen at admission is supported by two findings. First, the relationship between cognitive performance on admission and subsequent improvement in functioning was consistent for three domains of functioning, and from discharge to 90 days after discharge. Impaired cognitive performance on admission was associated with limited recovery both for routine tasks (e.g., basic ADL such as eating and bathing) and tasks that required higher-order cognitive processing (e.g., IADL such as managing money and using the telephone). The relationship between cognitive performance on admission and maintenance or improvement in mobility (tasks with much less cognitive demand) was significant as well. Second, in multivariate analyses and subgroup analyses we demonstrated that the association remained statistically significant after we controlled for a number of potentially confounding factors, including baseline functioning, advanced age, acute illness, comorbidity, and signs of delirium.

Our findings do not determine the mechanism of the association we observed, though the consistency of the findings for ADL, IADL, and mobility suggests that poor performance on a cognitive status screen reveals defects in processes that are needed to maintain and recover functioning after an acute illness and hospitalization. Although future research is needed to identify the processes that are involved in the maintenance and recovery of functioning after hospitalization, the consistent ordering of rates of recovery by level of impaired performance on a cognitive status screen indicates that measurement of cognitive impairment along a continuum would be more informative than only an assessment for the presence or absence of a defect in the processes.

Methodologic Considerations
The validity of our results is supported by use of a large representative sample, measurement of functioning in several domains over multiple points in time, and measurement of several potentially confounding factors. The major limitation of the study is that we cannot define the etiology and clinical characteristics of patients’ cognitive impairment on admission. This is because comprehensive neurologic assessments were not conducted at admission, and for many patients it could not be determined whether they had experienced a change in cognitive status from 2 weeks before admission to the time of admission. It is typical for physicians to have inadequate documentation of patients’ prior cognitive functioning at hospital admission.
One study documented that half of the patients with cognitive impairment at admission had no record of cognitive impairment in their medical notes (27). Consequently, a cognitive status screen is often the only feasible means by which to quickly assess patients' level of cognitive impairment at admission. Cognitive status exams are particularly useful for identifying cases of mild to moderate cognitive impairment that often go undetected at hospital admission (27). Cognitive status exams are not designed to distinguish chronic from acute cognitive impairment. However, in subgroup analyses we showed that the results were consistent when patients with any signs of delirium were eliminated from the sample.

Another potential limitation of this study was the greater use of surrogate reports of functioning for patients with severe cognitive impairment. Bias was reduced in our main outcome, change in functioning, by using valid and reliable measures, and by maintaining the same source for each subject's data throughout the study whenever possible. Prior studies have shown that surrogate bias is lowest for measures of daily functioning (14,28,29), and that when bias does occur, it is in the direction of overestimation by caregivers of patients' level of functioning. The effect of this bias would be to reduce functional differences among groups, whereas we found consistent evidence for significant differences among the three cognitive groups. Finally, it is possible that the reliability of self-report measures of functioning may be compromised in the acute care setting. The effect of this reduced reliability would be to reduce the power to detect statistically significant differences among the groups; however we found significant differences among the three cognitive groups in all three domains of functioning.

Implications

Our findings provide evidence that screening acutely hospitalized older patients' cognitive status is important for predicting functional outcomes after admission and discharge. Cognitive impairment in hospitalized elders often goes unrecognized (27,30–32), but we demonstrated that a brief cognitive status screen can be useful for identifying levels of cognitive impairment at admission that are associated with significantly different functional outcomes. There are immediate and long-term implications of these findings. The immediate implication is that cognitive screening will identify patients who are vulnerable to functional decline and will likely require more intensive care during and after hospitalization to address their new functional dependencies. We recommend that hospitals routinely screen older adults’ cognitive functioning at admission and use this information when formulating discharge plans for patients who experienced loss of functioning during the course of the acute illness and hospitalization. This recommendation is similar to those proposed by the Assessing Care of Vulnerable Elders (ACOVE) Project, which provides evidence-based quality of care recommendations for community-living older adults who are vulnerable to functional decline (33).

The long-term implication of our findings is that interventions must be developed that specifically address prevention and treatment of the disproportionate amount of functional decline that occurs during the course of acute illness and hospitalization for older adults with cognitive impairment. The recognition of the need to intervene and treat patients with cognitive impairment is evidenced by Medicare’s new mandate to cover treatments designed to improve functioning in Alzheimer’s patients such as occupational and physical therapy (34). This mandate follows evidence that dementia patients can derive significant benefits from treatment and therapy. It is not known whether current interventions designed to improve functioning in acutely hospitalized elders meet the specific needs of patients with cognitive impairment. Future research should be directed toward developing and testing interventions that are specifically designed to improve functional outcomes in hospitalized older patients with cognitive impairment.

Conclusions

In conclusion, improving care for vulnerable older adults begins with identifying which conditions put older adults at risk for functional decline. We determined that a cognitive status screen could easily stratify hospitalized older adults according to their likelihood of losing functioning. Clinicians can use this information to modify care plans for
cognitively impaired patients who are at high risk of losing functioning. Policy makers can use this information to support the development of procedures and interventions to prevent and treat functional loss in cognitively impaired hospitalized elders.

ACKNOWLEDGMENTS

This work was supported by National Institutes of Health Grants AG-10418, AG00714(K08), and AG00888(K23) to Drs. Landefeld, Covinsky, and Yaffe, respectively. Additionally, support was provided by the John A. Hartford Foundation, Inc. (C.S. Landefeld, Principal Investigator grant 97229), and the Summa Health System Foundation, Akron, OH (S. Counsell, Principal Investigator).

We thank Chris Burant, MA and Lily Lui, MA for their assistance with data preparation and analysis.

Address correspondence to Laura P. Sands, PhD, Purdue University, 1337 Johnson Hall of Nursing, West Lafayette, IN 47907-1357. E-mail: lsands@ursing.purdue.edu

REFERENCES


