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The Utility of Neuropsychological Consultation in Identifying Medical Inpatients with Suspected Cognitive Impairment at Risk for Greater Hospital Utilization

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Abstract

Objective: This was a retrospective study designed to examine the relationship between inpatient neuropsychological status and future utilization costs.

Methods: We completed a retrospective chart review of 280 patients admitted to a large academic medical center who were referred for bedside neuropsychological evaluation. Patients were grouped based on neuropsychological recommendation regarding level of supportive needs post discharge (low, moderate, high). Level of support was used as a gross surrogate indicator of cognitive status in this heterogeneous sample. We also included patients who refused assessment. Outcome variables included time to readmission, number of emergency department visits, inpatient admissions, length of hospitalization, and total costs of hospitalizations, 30 days and 1 year following discharge.

Results: Multivariate analysis indicated patients who refused assessment had higher inpatient service utilization (number of ED visits, number of admissions, and total cost of hospitalization) compared to those with moderate needs. Also, high needs patients had higher total cost of hospitalization at 1 year, and those with low needs used the ED more, compared to those with moderate needs.

Conclusions: Our findings replicate prior studies linking refusal of neuropsychological evaluation to higher service utilization costs, and suggests a non-linear relationship between cognitive impairment severity and future costs for medical inpatients (different groups incur different types of costs). Results preliminarily highlight the potential utility of inpatient neuropsychological assessment in identifying patients at risk for greater hospital utilization, which may allow for the development of appropriate interventions for these patients.

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Conflict of Interest

The authors have nothing to disclose and report no conflicts of interest.

Keywords

health care utilization; neuropsychological assessment; clinical neuropsychology; hospital utilization

Introduction

Since the Affordable Care Act (ACA) of 2010, the APA and its leadership have encouraged empirical studies supporting inclusion of psychologists in healthcare teams (Goodheart, 2010). Within the field of neuropsychology, even earlier in the era of healthcare reform, Prigatano and Pliskin (2003) argued for the incorporation of healthcare economics models into research demonstrating the efficacy and utility of neuropsychological services. There continues to be strong support and calls for documenting the utility of neuropsychological services in order to advance and adapt neuropsychological practice to the modern healthcare environment (Chelune, 2010; Goldstein, 2010; Kubu, Ready, Festa, Roper, & Pliskin, 2016; Prigatano & Morrone-Strupinsky, 2010; VanKirk, Horner, Turner, Dismuke, & Muzzy, 2013).

One study, VanKirk, Horner, Turner, Dismuke, and Muzzy (2013), sought to evaluate the objective value of outpatient neuropsychological evaluation through reduction in Emergency Room (ER) visits and hospitalizations in a sample of 440 US Veterans. Within-subject comparisons showed significant decreases in incidence of hospitalization and length of hospitalization in the year after outpatient neuropsychological evaluation compared to the year prior that was not attributable to age or time. Incidence of ER visits also decreased from pre to post-evaluation, though it was not significant. These findings provide preliminary evidence of the clinical and potential economic value of outpatient neuropsychological services within a medical setting (VanKirk, Horner, Turner, Dismuke, & Muzzy, 2013).

Another study completed a year later by Horner, VanKirk, Dismuke, Turner, and Muzzy (2014) on the same sample of veterans, examined whether inadequate effort was associated with increased health-care utilization. Only the subset of patients who had been administered standard validity measures were included. Of the 355 patients identified for inclusion, 283 (79.7%) showed adequate effort, and 72 (20.3%) showed inadequate effort. Analyses found inadequate effort and lack of cooperation with outpatient neuropsychological evaluation to be associated with increased health care utilization in the form of more ED visits, hospitalizations, and more days of hospitalization within the year after evaluation, compared with cooperative patients. In sum, this study showed patients who exerted inadequate effort showed greater health-care utilization in the year following evaluations (Horner, VanKirk, Dismuke, Turner, & Muzzy, 2014).

On a related note, recent studies exploring high service utilization and hospital re-admission rates (in both national and international arenas) reported cognitive impairment as an associated risk factor for higher readmission in conditions such as recently diagnosed myocardial infarction (MCI), heart failure, hepatic encephalopathy, and in ED admitted older adults (Ball, Carrington, & Stewart, 2013; Callahan et al., 2015; Saab, 2015; Deschodt et al., 2015; Sperry, Ruiz, & Najjar, 2015). Other studies directly link health status (such as

cardiac status and obesity) with cognitive impairment (Stanek, et al., 2011; Gunstad, et al., 2007).

This prior research suggest greater cognitive impairment is significantly associated with greater hospital utilization, and patients who are non-compliant with neuropsychological assessment may have significantly greater hospital utilization than those who were compliant. Neuropsychologists practicing within inpatient hospital settings are well positioned to contribute to the literature regarding cognitive impairment as an associated risk factor for higher hospital readmission rates and service utilization costs (Kubu, Ready, Festa, Roper, & Pliskin, 2016). However, to date, no studies considering the utility of *inpatient* neuropsychological consultation have been completed.

This was a retrospective study designed to examine the relationship between inpatient neuropsychological status and future utilization costs. The present literature suggests two specific hypotheses: (1) greater cognitive impairment is significantly associated with greater hospital utilization, and (2) patients who were non-compliant with neuropsychological assessment will have significantly greater hospital utilization than those who were compliant. Of note, while all inpatient subjects selected did complete a neuropsychological evaluation of cognitive status, a surrogate indicator of cognitive status (recommended level of support upon discharge) was used to execute this research for a variety of reasons detailed below.

Methods

Research Design

This research was approved by Northwestern University Institutional Review Board. The study utilized a cross-sectional retrospective design to systematically examine electronic medical records (EMR) of 280 patients admitted to a large Midwestern academic medical center, who had suspected cognitive impairment, and were referred for inpatient neuropsychological assessment for determination of dispositional decision-making capacity and post-hospitalization needs as part of discharge planning.

Patients were ultimately grouped primarily using recommended level of post-discharge support for multiple reasons, (1) this was assumed to be a gross surrogate indicator of level of cognitive functioning for this initial exploratory report (the clinicians made recommendations regarding level of support based on cognitive status), (2) this was an easily and consistently identifiable element of most archival consultation reports, (3) grouping based on cognitive scores alone presented multiple challenges as different groups of patients were typically able to tolerate different measures (i.e. patient with severely impaired cognitive functions often could not tolerate the entire battery), and (4) archival test scores taken in isolation (outside of all highly relevant clinical and situational context considered during bedside inpatient neuropsychological evaluation) may not accurately reflect the clinical decisions made at the time of the evaluation.

Outcome analyses examined group differences in readmission rates, service utilization, and cost (emergency room visits and inpatient stays), within an initial 30-day post-hospitalization period, and a longer 1-year period.

Participants

Cases for inclusion were considered by archival record selection and identified via a combination of the Neuropsychology Service database and the EMR. Neuropsychological reports for the selected cases were reviewed to code the independent variables. Outcome variables were harvested from the EMR by the independent Electronic Data Warehouse service. Records of adult patients referred to the Neuropsychology Service for determination of decision-making capacity and dispositional recommendations between September of 2011 and April of 2015 were initially harvested for further examination (N = 329). This time frame was based on the most complete departmental record availability, and the need to allow for a full 1 year time-elapse for outcome measures at the onset of research (research began in the summer of 2016). Table 1 outlines the cases identified for exclusion.

Of note, if subsequent evaluations were completed on the same individual greater than one year apart (for example, the same person was seen once in 2010, then again in 2014), each instance greater than one year apart was deemed a distinct consultation-outcome point in our analyses. This was a small sub-set of individuals, N=13, but as noted above (repeat consultations within 1 year), repetitive consultations are not infrequent in an inpatient medical setting. The final study sample included 280 cases.

The evaluation procedures (conducted for clinical purposes, well before this research was conceived) included a medical record review, clinical interview, bedside neuropsychological evaluation, and review of relevant diagnostic data (e.g. neuroimaging, labs). The typical battery included the Test of Premorbid Functioning (TOPF); Wechsler Adult Intelligence Scale-4th Edition (WAIS-IV) Digit Span, and Similarities subtests; the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS); Trail Making Test; Stroop Test; Verbal Fluency tests; and selected subtests of the Independent Living Scales (ILS), typically the Health and Safety Subtest. Capacity determination and estimation of post-hospitalization support needs were based on the degree of cognitive impairment and the patient's ability to independently grasp the discharge plan as outlined by the primary team, outline a reasonable and safe discharge plan, and appreciate the risks and benefits of independent versus supported living.

Table 2 outlines the demographic characteristics of the study sample. Overall, the sample was primarily female (59.7%), Caucasian (63.5 %), and elderly (mean age = 73.4, range = 19 – 97). Table 3 details the type and percentages of medical comorbidities present across the total sample and each group. The number of medical comorbidities was coded to emulate the "number of dysfunctional bodily systems" categories used by VanKirk, Horner, Turner, Dismuke & Muzzy, 2013. Each bodily system/medical comorbidity category received a binary score of 1 or 0. The total score is the sum across all categories, and represents the number of dysfunctional bodily systems rather than a "count" of all present comorbidities. Patients had an average of four medical comorbidity categories (range = 0 – 9). One-way ANOVA and post hoc multiple comparisons revealed the low needs group to be significantly

younger than the high needs (p = .002) and refusal (p = .006) group. All other demographic comparisons including chi-square for sex and race, and one-way ANOVA for total number of medical comorbidities across groups were non-significant (p>.05).

Table 4 outlines the guiding criteria used to make patient group assignments. Group assignment was coded by two independent raters (ES and CM). An intraclass correlation coefficient (ICC) estimate and 95% confidence interval was calculated using SPSS statistical package version 23 (SPSS Inc, Chicago, IL) based on a mean rating (k=2), consistency-agreement, 2-way random effects model. ICC = .970 with 95% confidence interval = .960-.977, indicating excellent interrater reliability. Due to a high level of interrater reliability, the first examiner's ratings (ES) were used to complete the analysis.

Outcome Variables

Time to readmission, number of emergency room visits, number of hospitalizations, aggregate length of hospitalization, and total cost of inpatient hospitalizations, served as outcome variables for this study. Total cost of inpatient hospitalizations was provided by the Electronic Data Warehouse and is the total sum of each emergency department (ED) visit and inpatient hospitalization cost incurred during the designated follow up period (eg. ED1 Cost + ED2 Cost +….Hospitalization1 cost + Hospitalization2 cost + …). The cost for each ED visit and inpatient hospitalization included all charges billed from admission to discharge. Follow up outpatient visits were not included in inpatient hospitalization cost. Analyses examined two follow-up periods (initial and extended). Because Medicare penalizes institutions for readmission within 30 days of discharge, the initial follow-up period was set at 30 days following the index hospitalization (Callahan et al., 2015). The extended follow-up period was set at one year following the index hospitalization, based on prior outpatient neuropsychological outcome studies (Horner, VanKirk, Kismuke, Turner, & Muzzy, 2014; VanKirk, Horner, Turner, Dismuke, & Muzzy, 2013). The one-year cost was the total annual cost (the above formula applied for the duration of the year).

Statistical Methods

Ten multivariate models were used to examine the association of group with time to readmission, number of ED visits, number of readmissions, length of stay, and total cost at 30 days and 1 year after the index hospitalization. Each of the models also controlled for other theoretically related variables based on literature (age, sex, race, and baseline medical comorbidity score), if found to be associated with service utilization. Time to readmission across groups was analysed using Cox Proportional Hazards Models, with separate analysis for 30 day and 1 year outcomes. Mean number of ED visits and readmissions within 30 days of discharge across groups was compared using Poisson Regression Analysis. Mean number of ED visits and readmissions within one year of discharge across groups was compared using Negative Binomial Models to accommodate for overdispersion bias. Length of stay and total cost of inpatient hospitalizations across groups for 30 day and one year outcomes were first log transformed and then analysed using General Linear Regression analysis. Statistical significance was set at alpha level of 0.05. Data were analysed using R version 3.3.2.

Results

Group statistics comparing the unadjusted means of the healthcare utilization variables are shown in Table 5, and statistically significant findings are graphically represented in Figures 1–4. Multivariate analysis indicated the moderate needs group had the lowest overall inpatient service utilization, and this group was therefore used as a reference group for subsequent analyses.

Compared to the moderate needs group, patients who refused assessment and the high needs group (i.e. the most cognitively impaired group), demonstrated significantly higher inpatient hospitalization costs over the extended (i.e. 1-year) follow-up period (Adjusted R^2=0.176; p = .0002). Translated into dollar amounts, the average patient who refused neuropsychological evaluation incurred $39,466 in service utilization costs (p = .001), compared to $27,844 for the average high needs patient (p = .004), and $18,401 and $19,448 for the low and moderate needs patients, respectively.

Patients who refused assessment and the low needs group (i.e. those with least degree of cognitive impairment) demonstrated a higher number of ED visits across the initial and extended follow-up periods compared to the moderate needs group (Wald Test p < 0.001). Specifically, 30 days after discharge, the low needs group was on average 3.5 times more likely to visit the ED (RR = 3.69 (1.29–12.97), p = .024), and those who refused evaluation were nearly three times more likely to visit the ED (RR = 2.9 (1.11–10.06), p = .051), compared to the moderate needs group.

One year after discharge, the low needs group was on average 6.5 times more likely to visit the ED (RR = 6.46 (1.59–26.39), p = .006), and those who refused evaluation were nearly eight times more likely to visit the ED (RR = 7.80 (2.13–26.77), p = .0007), compared to the moderate needs group.

Only the refusal group demonstrated a higher number of readmissions over one year (Wald Test p<0.001), specifically being nearly twice as likely as those with moderate needs to be readmitted (RR = 1.98 (1.06–3.68), p = .031).

Time to readmission, length of inpatient stay, and the inpatient hospitalization cost over the initial 30-day post-hospitalization period did not differ significantly between patient groups.

While true level of care after discharge is not known in our sample, as a post-hoc exploration we considered the level of care as stated in the discharge notes compared to the level of care we recommended: Low Needs Group (N = 40; Discharge: Low 27, Moderate 10, High 3), Moderate Needs Group (N = 39; Discharge: Low 8, Moderate 17, High 14), High Needs (N = 125; Discharge: Low 4, Moderate 11, High 110), Refusal (N = 76; Discharge: Low 29, Moderate 4, High 43).

Discussion

Explanation of Findings

Results suggest those who refuse inpatient neuropsychological assessment have greater hospital utilization and incur higher inpatient healthcare utilization costs, compared to patients identified as moderate needs by neuropsychological evaluation. This finding replicates prior research associating poor effort on outpatient neuropsychological evaluation with higher hospital utilization (Horner, VanKirk, Dismuke, Turner, & Muzzy, 2014). This finding was consistent with our second hypothesis.

The authors agree with prior explanations for this finding put forth in the literature: (1) inadequate effort on examination may serve as a "marker" for these patient's more general lack of full cooperation in their own healthcare, (2) due to a lack of cooperation there is reduced diagnosis clarity and therefore lack of appropriate treatment, and (3) intentional production or embellishment of symptoms leading to greater healthcare usage (Horner, VanKirk, Dismuke, Turner, & Muzzy, 2014). Also, there may be differences between inpatient and outpatients with respect to motivations to participate in neuropsychological assessment. For example, overt obstinance in the setting of relative inpatient medical stability, versus severe medical illness and feeling too ill for participation, versus refusal due to low health literacy.

Our results also suggest there is not a linear relationship between cognitive impairment severity and future costs for inpatients, and those with high needs and those with low needs incur greater costs on different variables relative to those who fall in the middle. More specifically, those with low needs incur higher ED costs, and those with high needs incur higher inpatient hospitalization costs, relative to those whose needs fall in the middle. This finding was contradictory to our first hypothesis.

One possible explanation for the moderate needs group having the lowest readmission and service utilization rates is they may be more likely to be discharged to a higher level of care than recommended, thereby facilitating medical stability (40% of our moderate needs sample was actually discharged to a high level of care per post-hoc analysis). Low needs patients may be able to recognize the need for medical attention, prior to their conditions becoming destabilized to a point that necessitates admission and more intensive treatment, but resulting in higher ED utilization. We suspect patients with high needs (and severely impaired cognitive status) may tend to undergo extensive neurologic work up at each admission (e.g. MRI, neurology consultation, psychiatry consultation) contributing to mounting costs.

Future Studies

For those who refuse inpatient assessment, future studies may wish to further clarify the nature and type of inpatient refusal (e.g. feeling too ill, obstinance, low health literacy), and consider other aspects of their hospitalization or medical history to find targets of intervention and prevention of high service utilization in this population. For the low needs patients, future studies might further clarify the nature and type of ED usage. It may be possible to develop a metric to describe "false-alarm" versus "accurate" ED use (patients

who receive necessary brief treatment and are sent home) to further understand this higher relative cost. For all groups (but of most interest for the moderate and high needs groups), the examiners plan to conduct a future study examining if there is any effect of whether our recommendations were followed on later hospital utilization.

Potential Interventions

Specifically given our findings, post-discharge interventions for the more cognitively intact patients may be aimed at reducing the number of ED visits via closer primary care physician (PCP) follow-up immediately after discharge and throughout the following year. Similarly, early identification and intervention for individuals with poor medication compliance and resistance to treatment may possibly reduce the development of more profuse maladaptive refusal behaviors in the future. Extrapolations may be considered from the psychological literature regarding ways to therapeutically handle resistance or symptom exaggeration. However, caution and possible ethical consideration is imperative given the acute health needs and risks to health/life at the time of medical admission.

Generally, the known potential impact of neurologic, cardiac, psychiatric, and renal comorbidities on cognitive function (and the high prevalence of these comorbidities in our sample) may suggest individuals with these comorbidities should be screened for cognitive impairment at regular intervals. A simple screening measure such as the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005) could be used.

The primary care behavioral health model of collaboration may be a helpful model to emulate, offering in-office screenings and consultations and more extensive outpatient evaluations and services as needed. A primary care behavioral health model has shown effectiveness in improving patient outcomes and reducing healthcare costs in comorbidities of depression, obesity, and diabetes among others (Conejo-Ceron et al., 2017; Trickett, Matiaco, Jones, Howlett, & Early, 2016). Integration of neuropsychological services in primary care settings may foster greater medical stability, reduce hospital utilization, and reduce overall healthcare costs for patients with multiple medical comorbidities.

Limitations

Specifically regarding this study, our ability to detect significant group differences may have been limited by insufficient power. Future large-scale studies or meta-analyses may be able to detect finer differences in hospital utilization. Also, the generalizability of our findings may have been negatively affected by several factors. Firstly, our group classification strategy was based on case-by-case clinical decision-making as opposed to a standardized scheme. Secondly, we only examined inpatient service utilization costs and did not consider cost of outpatient medical follow up and medication usage. Thirdly, we were not able to capture ED visits and hospitalizations outside our health system. Fourthly, we did not directly consider the impact of education on our results. While education is corrected for, and taken into account in the archival clinical process we considered, we did not directly control for this variable in our outcomes.

More generally, the study of the inpatient neuropsychological population is presently limited by the characterization of medical comorbidities. The present neuropsychological literature

to-date (including this study) utilizes a crude “number of dysfunctional systems” proxy. More elegant models of medical comorbidities such as the Charlson index, Elixhauser comborbidity measure, or comorbidity-polypharmacy score may be helpful to consider with regards to relevance in neuropsychological research (Charlson, Pompei, Ales, & MacKenzie, 1987; Elixhauser Steiner, Harris, Coffey, 1998; Justiniano, et al., 2013). Also, there is presently no precedent, or consensus regarding inclusion/exclusion of repeat cases who belong to a notorious “revolving door” group of inpatients seen multiple times within a year, or at regular intervals for consecutive years. This high-repeat group may likely have its own unique needs but this has not been explored or validated from a neuropsychological standpoint.

Conclusions

Overall, our findings replicate prior research linking lack of cooperation with neuropsychological evaluation with higher service utilization costs, suggests a non-linear relationship between cognitive impairment severity and future costs for medical inpatients (different groups incur different types of costs, indicating a multivariate nature), extend prior findings to include acute medical inpatient settings, and offer more direct examination of post-hospitalization fiscal impact by analyzing the *actual* accrued costs as opposed to a national average estimate. Our findings demonstrate the potential utility of neuropsychological evaluation in identifying groups of patients at increased risk for greater hospital utilization. We hope these results, along with the growing body of literature highlighting the importance of neuropsychological services within healthcare systems, emphasize the need for further integration of neuropsychological services within both inpatient and outpatient medical care settings.

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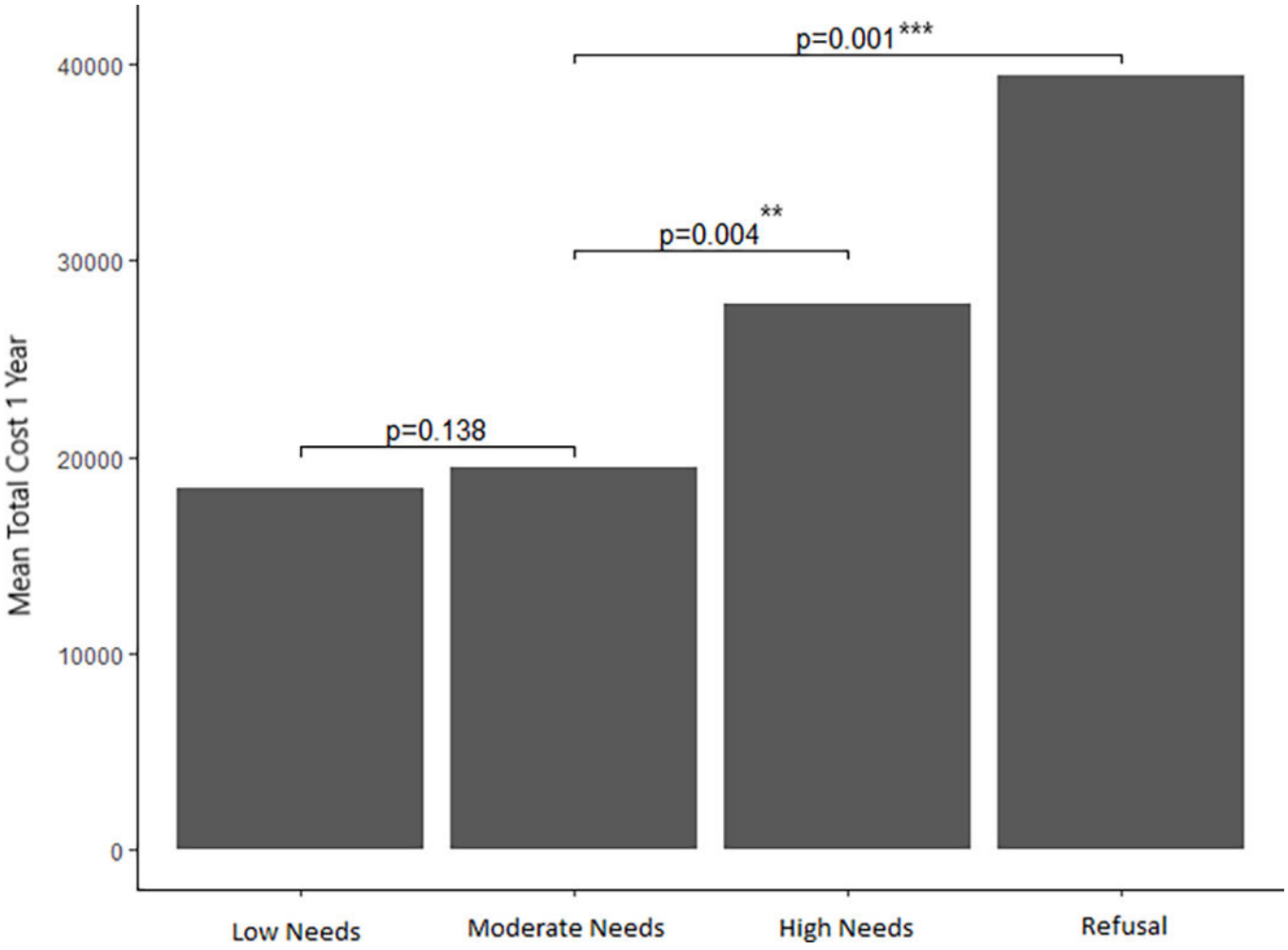

Figure 1.
Mean Total Cost in 1 Year by Group and Their Significance

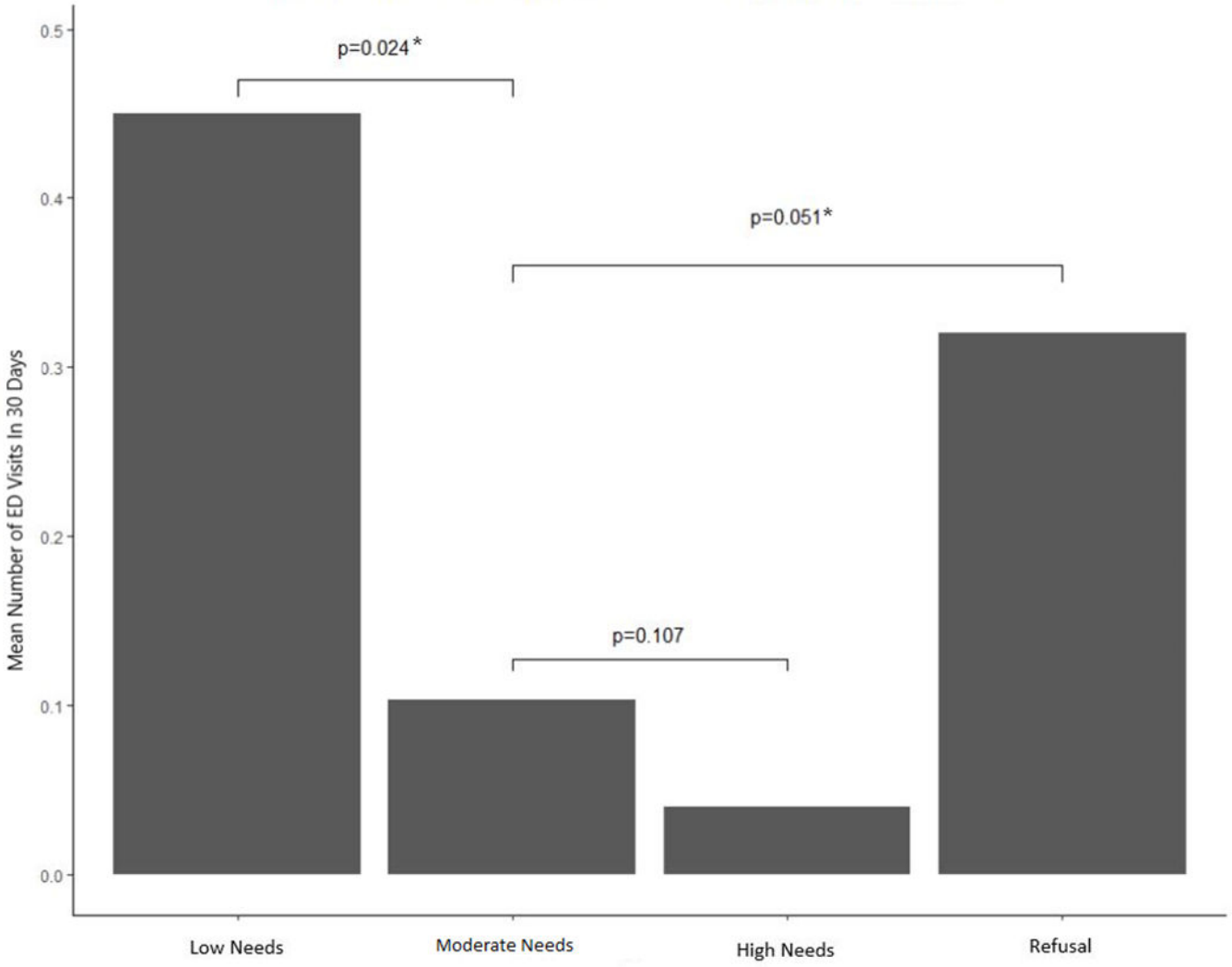

Figure 2.
Mean Number of ED Visits in 30 Days by Group and Their Significance

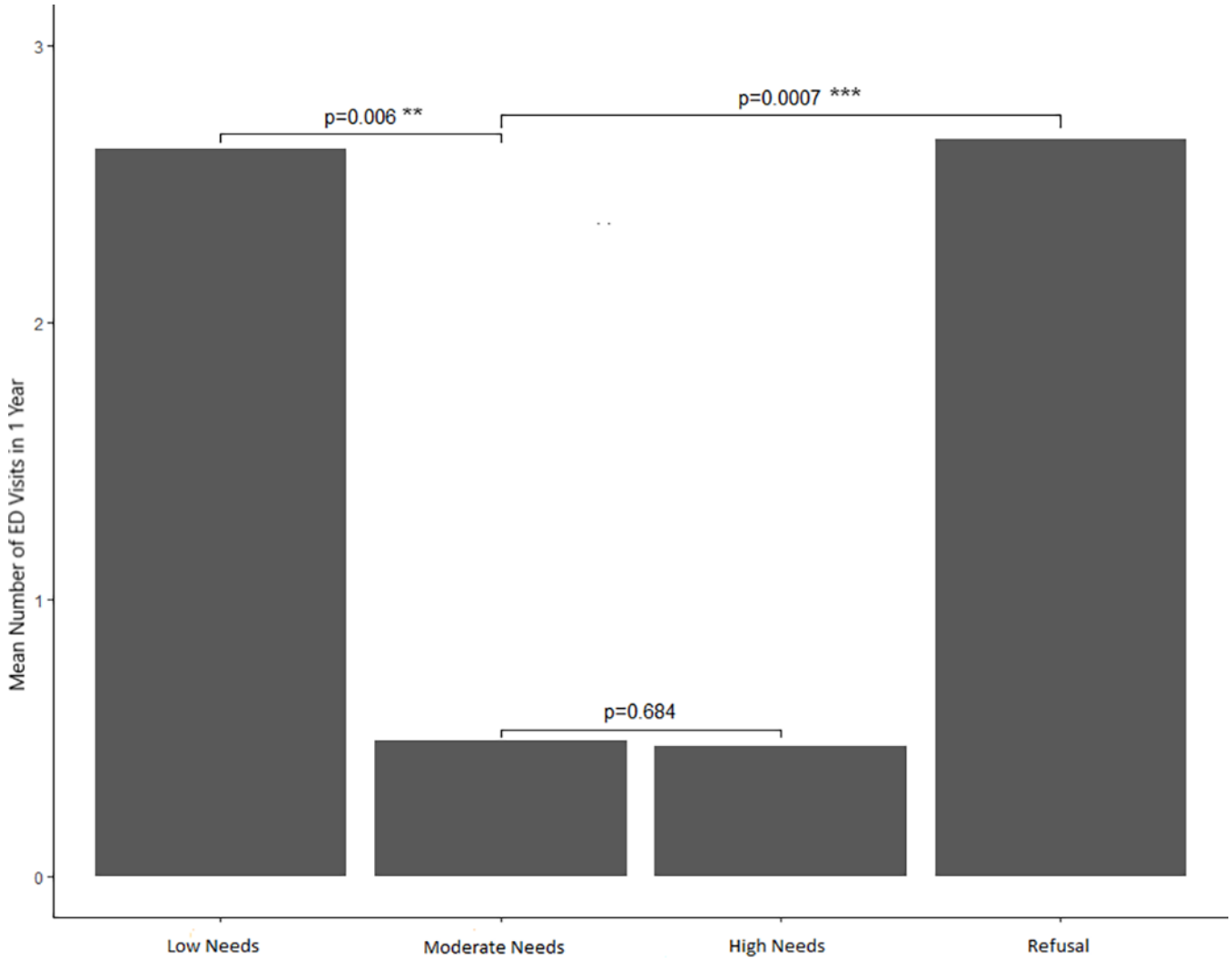

Figure 3.
Mean Number of ED Visits in 1 Year by Group and Their Significance

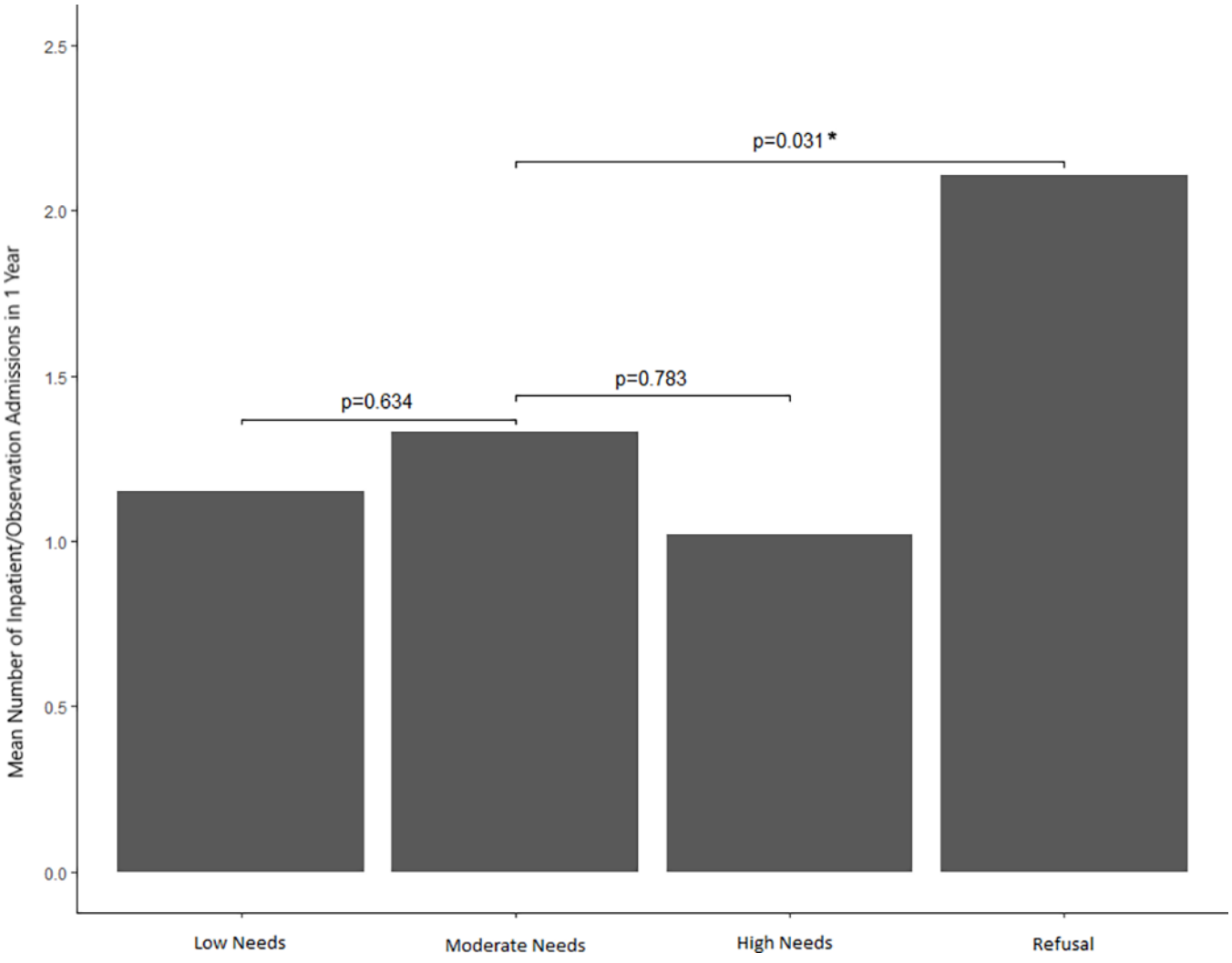

Figure 4.
Mean Number of Inpatient/Observation Admission in 1 Year by Group and Their Significance

Table 1.

Description of excluded cases

Number Excluded	Rationale
N=15	Primary mental illness; case referred to Psychiatry Consultation Liaison Team
N=15	Repeat evaluation time <1 year
N=7	No discharge recommendation provided
N=3	Patient transferred to another medical facility
N=3	Death prior to discharge
N=2	24/7 Palliative care upon discharge (unrelated to cognitive status)
N=1 (each)	Leaving against medical advice (AMA) 24/7 Care upon discharge due to sensory limitation Erroneous medical record Unclear discharge/transfer to another country

Table 2.

Descriptive statistics of the study sample

	Low Needs	Moderate Needs	High Needs	Refusal
Number of patients	40	39	125	76
Sex [N (%)]				
Male	16 (40%)	15 (38.5%)	57 (45.6%)	28 (36.8%)
Female	24 (60%)	24 (61.5%)	68 (54.4%)	48 (63.2%)
Race [N (%)]				
Caucasian	31 (77.5%)	23 (59.0%)	68 (54.4%)	48 (63.2%)
African American	8 (20%)	12 (30.8%)	42 (33.6%)	25 (32.9%)
Other	1 (2.5%)	4 (10.2%)	15 (12.0%)	3 (3.9%)
Age [Median (Range)]	63.5 (19 – 95)*	77 (22 – 93)	77 (22 – 97)*	76 (29 – 93)*
Number of Medical Comorbidities [Median (Range)]	4 (1 – 8)	4 (0 – 9)	4 (1– 9)	5 (2– 8)

Note. *p<.05

Table 3.

Descriptive statistics of medical comorbidities

	Total Sample [N (%)]	Low Needs [N (%)]	Moderate Needs [N (%)]	High Needs [N (%)]	Refusal [N (%)]
Neurological	133 (48%)	19 (48%)	15 (38%)	62 (50%)	37 (30%)
Cardiovascular	217 (78%)	26 (65%)	20 (74%)	97 (78%)	64 (52%)
Endocrine	102 (36%)	12 (30%)	15 (38%)	46 (37%)	29 (23%)
Gastrointestinal	49 (18%)	5 (13%)	7 (18%)	16 (13%)	21 (17%)
Infectious Disease/Autoimmune	68 (24%)	10 (25%)	6 (15%)	29 (23%)	23 (18%)
Musculoskeletal	76 (27%)	5 (13%)	6 (15%)	36 (29%)	29 (23%)
Pain	33 (12%)	4 (10%)	5 (13%)	11 (9%)	13 (10%)
Pulmonary	88 (31%)	10 (25%)	13 (33%)	37 (30%)	28 (22%)
Cancer	56 (20%)	9 (25%)	12 (31%)	23 (18%)	12 (10%)
Sensory-Perceptual	39 (14%)	8 (20%)	4 (10%)	19 (15%)	8 (6%)
Liver	17 (6%)	2 (5%)	6 (15%)	4 (3%)	5 (4%)
Cognition	66 (24%)	10 (25%)	10 (26%)	37 (30%)	9 (7%)
Psychiatric	126 (45%)	20 (50%)	18 (46%)	51 (41%)	37 (30%)
Substance Use	97 (35%)	13 (33%)	13 (33%)	49 (39%)	22 (18%)
Renal/Urogenital	123 (44%)	15 (38%)	19 (49%)	52 (42%)	24 (19%)

Note. Percentages rounded to nearest whole number

Table 4.

Group criteria guidelines

	Low Needs	Moderate Needs	High Needs	Refusal
Cognitive Functioning	Normal to mildly impaired cognitive function	Moderately impaired cognitive functioning	Severely impaired cognitive functioning	Unknown cognitive functioning Only completing an interview prior to refusal; only completed 1 test, then refusing all else Failed validity testing; testing results not believed accurate due to lack of cooperation and inconsistent and intermittently insufficient test taking effort Cooperation clearly limited accurate evaluation of cognitive status
Cognitive Functioning Descriptor Examples	Normal cognitive status, isolated mild retrieval based memory dysfunction, slowed processing speed, mild working memory impairment	Moderate attentional, executive, memory, language impairment	Severe attentional, executive, memory, or language impairment Global cognitive impairment	
Knowledge of general health & safety concepts	Intact knowledge of general health and safety concepts	Questionable knowledge of general health and safety concepts	Poor knowledge of general health and safety concepts	
Ability to Manage Medical Conditions	Deficits not expected to significantly interfere with ability to manage own medical conditions	Deficits expected to interfere with ability to manage medical conditions upon discharge	Deficits expected to interfere with ability to manage medical conditions *and* general safety upon discharge	
Example of Diagnosis	No diagnosis/normal cognitive status for age, MCI (e.g MCI due to cerebrovascular disease)	Resolving encephalopathy, suspected early dementia, major neurocognitive disorder of mild or moderate severity	Likely severe major neurocognitive disorder, likely advanced dementia	
Capacity Determination	Retained capacity for dispositional decisions	With or without capacity for dispositional decisions	Without capacity for dispositional decisions	Capacity deferred to medical ethics/legal
Level of Support Recommendation	No to minimal oversight recommended Able to care for self independently from a cognitive standpoint, or only brief weekly check-ins with family/nurse Commonly recommend independent compensatory aids such as use of an appointment book, pill box, etc.	Significant daily assistance required for medical management Assisted living facility, daily family help, paid help 3–4hrs/day 5 days week, Daily assistance with meals, medications	24/7 supervisory care required for medical management as well as general health and safety 24/7 family assistance, skilled nursing facility, locked dementia unit	No recommendation provided
Additional Information	Driving restrictions, or minor assistance needed due to physical limitations were not contraindications to low needs group membership	Could not go home and live independently Did not require full time 24/7 supervisory care		In rare cases, gross behavioral disturbance or obscenity with examiner; unwilling/unable to engage in meaningful exchange rendering accurate assessment of cognitive status impossible

Note. These criteria and examples are based on results *as stated* in archival neuropsychological reports. The examiners did not retrospectively re-analyze or re-interpret individual aspects of archival clinical data.

Table 5.

Unadjusted mean (SD) healthcare utilization as a function of group

	Low Needs	Moderate Needs	High Needs	Refusal
Time to Readmission [asrc]				
30 Days	7.14 (6.64)	13.29(6.24)	11.65(8.44)	13.25(10.32)
1 year	86.58 (93.26)	104.41 (94.39)	76.95 (101.52)	83.33 (99.49)
Number of ED Visits [asrc]				
30 Days	0.45 (1.57)*	0.10(0.38)	0.04(0.20)	0.32(0.10)*
1 year	2.63(10.44)**	0.49(1.00)	0.47(1.65)	2.66(6.30)***
Number of Inpatient Admissions [asrc]				
30 Days	0.38(1.10)	0.18(0.39)	0.30(0.54)	0.26(0.62)
1 year	1.15(1.96)	1.33(2.02)	1.02(1.46)	2.11(3.59)*
Length of Inpatient Stay [src]				
30 Days	6.83(5.12)	3.38(2.67)	7.53(5.16)	7.00(5.21)
1 year	11.43(8.95)	10.82(10.44)	11.85(8.7)	17.4(17.13)
Total Cost of Hospitalization [src]				
30 Days	9,170(8,071)	5,227(3,990)	14,008(12,836)	13.404(16,387)
1 year	18,401 (19,715)	19,448(23,026)	24,050(16,939)**	39,466(48,303)***

Note. *$p \leq .05$, **$p \leq .01$, ***$p \leq .001$

[a]age, [s]sex, [r]race, [c]comorbidities (number) were included in the multivariate models as indicated by superscripts