

Predictors of Length of Stay in an Acute Psychiatric Hospital

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Abstract

Length of stay (LOS) in acute psychiatric hospitals has been heightened in recent years with the current economic climate and a growing realization that health care costs need to be contained. This study was designed to identify predictors of LOS which are available at the time of admission. Charts of 391 admissions to an acute psychiatric hospital were reviewed on the basis of a pre-constructed checklist. Regression modeling with the natural logarithm of LOS as the dependent variable was used to identify a multivariate model for LOS. Age, marital status, involuntary admission and diagnosis of an affective disorder or a psychotic disorder were shown to be independent variables that predicted length of stay. These variables in a multivariate model accounted for approximately 19% of the variance in LOS.

Keywords: Length of stay; Acute psychiatric hospital; Chart review; Predictors

Introduction

Length of stay (LOS) in acute psychiatric hospitals has long been a focus of attention and this has been heightened in recent years with the current economic climate and a growing realization that health care costs need to be contained. Length of stay (LOS) has a strong positive relationship with the cost of hospitalization; thus, LOS has become an important marker for hospital administrators, third party payers, patients and also community health providers.

Longer hospital stays do not necessarily mean better mental health care, improved social adjustment or diminished psychopathology [1,2]. The locus of provision of psychiatric care has shifted from institutions to community mental health in USA and many other countries [3-6]. Length of stay in hospitals has drastically dropped in the USA [7].

Many patients are currently on managed healthcare plans and third payers prefer to keep inpatient stays to the minimum. The need of the health care provider to comply with the third party payers, in order to get complete reimbursements and prevent patients from paying out of pocket has put pressure on healthcare professionals to expedite discharges from inpatient facilities and provide optimum care at the same time.

Results from previous studies indicated that some factors which are useful for estimating LOS are available at the time of admission, and these variables might be systematically assessed and incorporated into clinical decision-making. For instance, studies from the past have consistently shown that substance abuse has been associated with shorter length of stay and higher readmission rates [8-10].

Information regarding factors which tend to prolong length of stay has been equivocal across the studies in the past. Some of the demographic variables suggested are: age, fluency in English, gender, marital status, legal status, type of admission, place of residence and employment status [9]. Treatment variables include: number of prior hospitalizations, psychotic features, receiving ECT and need for restraints for violent behavior [10]. Diagnostic variables implicated are: a primary diagnosis of a psychotic or mood disorder, psychiatric symptom severity, co-morbid medical conditions, outpatient treatment, activities of daily living (ADL) functioning at admission, required court proceedings to continue hospitalization [11] or use of involuntary medications. A study conducted in Japan found that strong positive correlations with LOS were inpatient capacity and proportion of involuntary admissions [12]. Higher Brief Psychiatric Rating Scale

(BPRS), positive symptom scores [11] or even subscales of BPRS have consistently been associated with longer length of stay [13].

Although the knowledge generated by such investigations can be useful in identifying significant correlation between single variables and LOS, such findings are of limited applicability when making real-world predictions on a case-by-case basis. At the time of admission, patients possess multiple demographic and diagnostic characteristics, some of which may be positively, and others negatively correlated with LOS. Thus, methods are needed which will somehow combine these multiple influences and arrive at a composite prediction.

Blais et al. conducted a retrospective study of 80 discharged patients to explore the association of 25 demographic, illness and treatment variables from preadmission screening with LOS. Multivariate analysis revealed that 10 variables independently accounted for 62% of the variance in LOS. When the equation obtained from the multivariate regression analysis was applied to the prospective sample, predictive power of the variables shrank to 17% and fewer individual variables were significantly associated with LOS [11].

As Blais et al. [11] point out, although the multivariate methodological approach employed in their study had a number of important advantages over prior work in the area, the study still suffered as a result of relatively small sample size and consequent unfavorable subject to variable ratio, which probably contributed to the degree of shrinkage on cross-validation. The purpose of the present study was to identify predictors of length of stay in an acute psychiatric hospital based on a large sample size of chart review.

Methods

Subjects for this study consisted of every third patient discharged from three adult inpatient units at a publically funded University affiliated acute care psychiatric hospital located in Central Missouri

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Received November 09, 2013; **Accepted** March 01, 2014; **Published** March 03, 2014

Citation: Ithman MH, Gopalakrishna G, Beck NC, Das J, Petroski G (2014) Predictors of Length of Stay in an Acute Psychiatric Hospital. J Biosafety Health Educ 2: 119. doi:10.4172/2332-0893.1000119

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Independent Variable	Parameter Estimate	Significance	Multiplicative Effect (ME)	95% Confidence Interval for ME	
Intercept	1.919	<0.001	6.81	5.68	8.17
Age	0.007	0.006	1.01	1.00	1.01
Married	-0.212	0.029	0.81	0.67	0.98
Involuntary Admission	0.211	0.008	1.24	1.06	1.45
Guardian	0.814	<0.001	2.26	1.53	3.33
Affective disorder	0.196	0.0178	1.22	1.03	1.43
Psychotic disorder	0.558	<0.001	1.75	1.42	2.14

Table 1: Collection of samples from different people.

from January 2006 to September 2009. The patients had to be more than 18 years of age for inclusion.

Data collection

The chart review was reviewed and approved by the ethics committee at the University of Missouri-Columbia. Two psychiatry residents familiar with the medical record used a checklist assessing 14 variables, to abstract data that were utilized for the study. The checklist contained items relating to such topics as diagnosis, prior hospitalizations, admission status (voluntary, involuntary, voluntary by guardian), prior living circumstances (e.g. homeless, supported community living, residential care facility, emergency room, jail or another hospital), as well as demographic variables and diagnostic variables.

Statistical analysis

Univariate analyses were performed to examine the association between LOS and individual diagnosis-related items, demographics, and admission characteristics. Because the distribution of LOS (in days) was highly skewed, nonparametric methods were used, including Spearman's Rank correlation coefficient and the Wilcoxon Rank Sum Test for group comparisons. Regression methods were used to derive a multivariate model of factors associated with LOS. Linear regression methods were used to develop a multivariate description of LOS. Standard linear regression methods derive from the assumption of a normally distributed outcome with constant variance. An examination of regression residuals indicated that neither assumption was satisfied but that regression with the natural logarithm of the LOS as the dependent variable stabilized the variance and normalized the error distribution.

The regression analysis was carried out in several steps. The first step was to fit a model using all diagnosis-related items with sufficient samples size and then remove non-significant ($p > 0.05$) predictors from the model. In this way we identified the most important diagnostic factors before conditioning on demographics. The second step was to add demographics and admission status to the diagnostic model and then exclude what was not statistically significant. Preliminary analysis revealed very low incidence of some diagnoses. Cognitive Affective disorder, Antisocial personality disorder, Anxiety, Borderline Personality Disorder, Mental Retardation, Other personality disorders, Psychotic disorders, & Substance abuse were excluded from the regression analysis as each represented fewer than 10 cases. This was an exploratory study so there was no formal rule used to set the minimum sample size, just a pragmatic decision that 6 was too few and 17 was enough to show an effect. The median overall LOS was 9 days, with an Interquartile range (IQR) of 10 days ($25^{th}=6$ days, $75^{th}=16$).

Results

In all, 391 patients were selected for inclusion in the study during

the time frame in which charts were sampled. Twenty-five charts had multiple missing data values and hence had to be excluded from the analysis. Fifty-six percent of the patients were male, and the average age was 37 years; 90% were Caucasian, 8% were African-American, and 40% were never married; 44% had completed High School or a GED, and 23% had completed college. These demographic variables were closely representative of the general population of the catchment area for this hospital. Diagnostically, 82% suffered from symptoms of a psychotic disorder, 66% carried diagnoses involving substance abuse disorders, and 62% had been hospitalized involuntarily. In terms of length of stay, the average was 14.6 days ($SD=18.9$).

The sample median LOS was 9 days with a range of 1 to 189 days. Statistically significant predictors of LOS were age, marital status, involuntary admission and a diagnosis of an affective or a diagnosis of a psychotic disorder. These variables in a multivariate model accounted for approximately 19% of the variance. Substance abuse was also shown to be a predictor for a shorter length of stay but was ultimately excluded from the final model based on lack of significance ($p=0.083$). Regression results for the final log linear model are given in Table 1. Because the model is multiplicative on the LOS scale, the multiplicative effect (ME) and associated 95% confidence interval for each factor is included. Age was mean-centered and the other predictors are coded as 1 for present and 0 for absent. Thus the model-based estimate of LOS is about 7 days for the hypothetical reference individual who is of average age (37 years), unmarried, voluntarily admitted without guardian involvement, and without affective disorder or psychotic diagnoses. LOS increases/decreases by about 1% per year difference from age 37, is about 20% shorter for the married patient, increases by about 24% with an involuntary admission and can be expected to be 26% longer when a guardian is involved. Relative to all other admission diagnoses, affective and psychotic disorders increase expected LOS by 22 and 75% respectively.

Discussion

As expected, utilization of a larger patient sample and a more statistically sound subject/predictor variable ratio resulted in considerable shrinkage in the percent of variance accounted for in LOS. Recall that in contrast to the current finding that about 20% of the variance was accounted for, Blais et al. [11] reported that 62% was accounted for in the analysis of their original sample.

Relative to past research finding in this area, there was significant positive correlation between length of stay and a diagnosis of affective disorder, psychotic disorder or mental retardation. The correlation has been found to be stronger with a diagnosis with psychotic disorders, suggesting that patients with psychotic disorder tend to stay longer in hospitals. This again is consistent with many other studies in the past [8,14,15].

We also found that substance abuse disorders were negatively correlated with the length of stay in our hospital, consistent with the

previous studies [8,10]. It is also notable that, though substance abuse disorder was marginally significant in univariate analysis, this variable was not included in the multivariate regression, as these disorders apparently co-vary with other variables, which are included in the multivariate model. Considering the demographic variables, male gender and non-single marital status was associated with a longer length of stay in our hospital. Increased social support in the form of marriage may facilitate discharge. Also, the patient status being involuntary or admitted by a guardian predicted a longer length of stay compared to patients who were admitted voluntarily which is consistent with previous studies [11].

Some of the variables were found to be predictive in previous studies have been excluded from our study, as they do not apply to our hospital. Since we do not use ECT very often in the hospital, this variable was not included, as it would introduce outliers in the data set. Also we do not use BPRS scales at admission, so this variable was unavailable.

Future research in this area needs to focus on variables which might account for the remaining variance in LOS, as the results of the current study indicate that 80% of the variance remains unaccounted for. Although it is doubtful that anything approaching perfect prediction can be achieved, one major source of missing variance may lie in classes of variables that are dynamic in nature [16].

Dynamic variables, in contrast with static variables such as gender and diagnosis, are characterized by their changeable and often situational nature. One class of dynamic variables almost certainly associated with LOS pertains to assessments of psychiatric symptomatology, with particular reference to those symptoms indicative of a patient's propensity for harm to self or others; this variable certainly plays a major role in the admission process, and subsequent to admission, it is almost axiomatic that fluctuations in a patient's assessed likelihood for harm to self or others plays a major role in the decision to ultimately discharge the patient.

When viewed from this perspective, harm to self/others is a variable which takes the form of a trajectory that is monitored by the staff of inpatient units over the hospital course. The heuristic value of this variable class is limited in the sense that a full trajectory of scores would provide only a few hours of lead time to engage in discharge planning, but it is likely that the trajectory of harm to self/others assessments during the first few days of hospitalization may predict LOS, since the maintenance of a high level of risk is almost certainly correlated with continued stay. On the other hand, patients with low levels of self/other harm potential on the day of admission may be relatively likely to be discharged early. In any case, multivariate statistical approaches such as those utilized by the present study and Blais et al. [11] have a distinct advantage under such circumstances, since multivariate predictive equations can accommodate multiple variables and sum both positively correlated and negatively correlated variables into a predictive equation which weighs each in a manner reflective of its predictive power, arriving at a LOS prediction which represents a composite estimate.

Limitations of the study

The current study is a retrospective chart review which implies that only the variables which were recorded and accessible in these records were studied. The multivariate regression model accounts for approximately 18% the variance in LOS. There may be other variables, predicting the length of stay among patients, which could be more apparent in a prospective study. The findings of the study, although consistent with previous studies in other hospitals, may not

be generalizable to other hospitals. Testing the model on a prospective sample is needed for further validation.

Conclusions

The retrospective chart review performed as part of this study was able to identify a number of demographic and diagnosis-related variables which were correlated with the length of stay in an acute psychiatric hospital. Gender, employment status, marital status, admission type and diagnosis were correlated with the length of stay in our hospital. Using a multivariate regression model, a male patient who was unemployed, admitted involuntarily or by a guardian, with a diagnosis of an affective or psychotic disorder was likely to have the longest length of stay. However, even when these variables were used in a multivariate equation, they were only able to predict about 20% or one-fifth of the total variance in LOS. A substantial portion of the remaining 80% needs to be accounted for if heuristically meaningful predictions can be generated. We suggest that much of this variance lies in dynamic assessments of psychiatric symptoms, most notably those reflecting changes in the likelihood of harm to self/others.

Implications for Behavioral Health

Length of stay (LOS) in acute psychiatric hospitals has long been a focus of attention, heightened in recent years with the current economic climate and a growing realization that health care costs need to be contained. LOS has a strong positive relationship with the cost of each hospitalization. Longer LOS also puts the hospital at potential financial risk as they must provide adequate documentation for necessity of care. This study was designed to identify predictors of LOS which are available at the time of admission. Identification of predictors for LOS may help early recognition of such key factors as early as the admission and greater emphasis can be focused on such patients to aid in early discharge. This will facilitate efficient allocation of resources to optimize care in behavioral health.

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