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ISSN 2474-7769

Journal of Psychiatry and Mental Health

Research Article | Volume: 2.1 | Open Access

# The Association between Length of Hospital Stay and Readmission for Pediatric Psychiatric Patient

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**Received date:** 19 Oct 2016; **Accepted date:** 25 Jan 2017; **Published date:** 31 Jan 2017.

**Citation:** Kagabo R, Hashibe M, Kim J, Kleinschmit K, Clark C, et al. (2017) The Association between Length of Hospital Stay and Readmission for Pediatric Psychiatric Patient. Psychiatry Ment Health 2(1): doi http://dx.doi.org/10.16966/2474-7769.116



## Abstract

The reported increasing hospital readmission of children and adolescents with psychiatric illness (pediatric psychiatric patients) continues to present as a public health concern. One question of particular importance is whether hospital length of stay during the initial treatment impacts readmission and use of resources. In this paper, the objective was to investigate the association between hospital length of stay in days and readmission for children with psychiatric illness who have received inpatient care. The focus extends to examining how length of stay changed for the different diagnoses, and how such change affected patient readmissions between 1999 and 2010. For the methods, descriptive statistics were calculated, and Receiver Operating Characteristic (ROC) curves were obtained to calculate area under the curve with length of stay as the analysis time. Length of stay was divided into 7-day increments for the first 35 days, thus providing the following length of stay categories: 1-7, 8-14, 15-21, 22-28, and 29-35 days. Generally, fewer days of hospital stay were not a direct predictor of readmission for many diagnoses. For some diagnoses, however, like the group of eating disorders few days of hospital stay may predict readmission as shown by the observed large area under the curve while using the ROC. Prospective research examining length of stay may be necessary to determine how length of stay interacts with other factors in predicting readmission.

**Keywords:** Pediatric psychiatric patients; Readmission; Hospital length of stay

## Introduction

The reported increasing hospital readmission of children and adolescents with psychiatric illness [1] presents a number of concerns to the public. Length of hospital stay may be one of the variables that could be of help to researchers and mental health or public health practitioners in addressing some of the concerns and design interventions. Length of stay has been recognized as a variable of interest to those involved in the care of others including, health service planners, economists, and clinicians [2,3]. Length of stay may be related to various issues in health care, including service utilization and management and use of resources which may include cost [2-5]. An investigation of hospital length of stay may be also a variable in understanding the readmission process of pediatric psychiatric patients. In this paper, we describe the observed changes in hospital length of stay between 1999 and 2010 for children and adolescents with psychiatric illness, also referred to as pediatric psychiatric patients in this paper, and we examine how changes in length of stay are associated with changes in the readmission process.

## Background

Hospitalization is a key in the treatment of psychiatric illness. With one in every five of hospital admissions, being psychiatric related, psychiatric illness accounts for a large portion of hospital stays [6]. The length of hospital stay related to mental or psychiatric illness has gone through dramatic changes, starting with the deinstitutionalization movement in the 1960s which called for getting the mentally ill out of institutions. Psychiatric beds started to decrease, which resulted in a decrease in long term care and an increase in acute care or acute beds for individuals with psychiatric illness [7]. There has also been a co-occurring increase in hospital admissions and readmissions for people with psychiatric illness [6,8,9].

The readmissions are very costly with an estimated 19% of Medicare beneficiaries readmitted within 30 days of discharge and costing an estimated $15 billion in health care expenditures annually [10]. Although mental health treatment expenditures grew only at a rate of 6.7% compared to all health care expenditures at 8%, the total expenditures rose from $33 billion to $100 billion between 1986 and 2003 [11].

Hospitals in the United States are under pressure to lower costs of treatment and at the same time increase the quality of care. A question to be asked is how does such pressure help improve the quality of care or does it force hospitals to offer less effective forms of treatment? [12]. Such debate is especially necessary when dealing with psychiatric illness among children and adolescents. It is known that the chronic nature and acuteness of some of the psychiatric illnesses require inpatient hospitalizations [13] which might be longer than other illnesses. There is also a possible association between cost and hospital length of stay [4], so it is possible that mental or psychiatric providers limit the hospital length of stay to lower costs and this could in turn predict the higher rates of readmission.

Another difficulty in cost is that hospitals are not always reimbursed what they charge, especially with the publicly funded patients of Medicaid. To get their actual cost of care paid, hospitals charge more where the uninsured end up paying higher amounts than the insured [4,14]. This may cause the uninsured patients to request an early discharge due to the inability to pay the excess amounts.

Using data from Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS) for 2000 to 2006, an investigation was done to identify the association between ADHD as a secondary diagnosis, length of hospital stay (LOS), and cost. Children with a diagnosis of ADHD on average had more days in the hospital compared

to those with no ADHD (1.71 days, P=0.029). Although not statistically significant, children with ADHD also spent more money (US $940, P=0.245) compared to those without ADHD [15]. While research has reported a generally decreased length of hospital stay, youths treated with psychotropic medicines have been reported to have higher length of hospital stays [16]. It is not completely clear what the social and economic impacts on cost of treatment are. This research only investigates a possible association between length of stay, and readmission changes between 1990 and 2010.

## Methods

The participants in this study were children and adolescents ages 3 to 17 who were inpatients for psychiatric illness at the University of Utah Neuropsychiatric Institute. The University Neuropsychiatric Institute is the only recognized Academic psychiatry specialty hospital in the state and region, and receives referrals from across the region. In order to abide by HIPAA rules to protect participants' protected health information, the study received ethical approval from the University of Utah Institutional Review Board. The study was a retrospective review, and there was no need to consent participants as approved by the IRB. Investigators did not obtain information on how many participants were voluntary or involuntary inpatients. After IRB approval, data were obtained from the University of Utah Health Sciences data warehouse.

These participants had to have been inpatients between 1999 and 2010. Any participants that stayed at the hospital longer than 365 days were excluded. After the exclusions, the total number of participants were N=7,265 almost equally divided between boys and girls.

Data analysis for this study was performed using Stata 12 statistical software. Simple descriptive statistics were calculated to see the change in length of hospital stay for the year categories 2000-2005 and 2006-2010. T-tests were calculated to test for statistical significance. Using the sensitivity and specificity theory, we estimated Receiver Operating Characteristic (ROC) curves to determine the area under the curves. The ROC curves analysis was performed to determine whether given the hospital length of stay we would be able to use the area under the curve to correctly predict if the patients would be readmitted after discharge. For ROC curves, length of stay was divided into 7-day increments for the first 35 days of inpatient stay resulting in the following length of stay categories: 1-7, 8-14, 15-21, 22-28, and 29-35 day categories. Investigators then examined changes in readmission with change of length of stay for any possible association for the different diagnoses, and for the years stated above.

ROC and areas under the curve (AUC) were estimated with the unit of analysis as LOS for depressive disorders NOS, major depression disorder, bipolar disorders, schizophrenia, and substance use. A good clinical test is one where the sensitivity and specificity are very high with the apex of the curve closest to the upper left corner in the graph. Researchers or providers may interpret the ROC curves differently; however, it is generally accepted that an AUC of 0.5 produces a straight diagonal line which is clinically meaningless and AUC which is equal to or less than 0.75 is not very useful [17,18].

## Results

For psychiatric illness, estimating cost of care can be a difficult process involving a number of variables. This cost is, however, largely determined by the number of days of inpatient care [4], which is referred to as length of stay (LOS) in this paper. Analysis of LOS was performed to identify any patterns of change for the different diagnoses between the years 1999-2005 and 2006-2010, and to identify how changes might have affected readmission. Table 1.1 shows the mean, median length of stay in days for the different diagnoses. The total percent of readmissions within one year of discharge remained almost unchanged from the period 2000-2005 to 2006-2010, and was 22.56% and 22.32% respectively. The slight change in readmission was not statistically significant with P=0.811, and measured at the level of P<0.05. The overall change in length of stay was also insignificant with P=0.226, and a trend of decreased length of stay days (Table 1.1). The group of eating disorders, which showed a slightly different trend were a small sample with n=32 for the years 2000-2005, and n=25 for the years 2006-2010. There was a slight observed increase in LOS for eating disorders, where in 2000-2005, the mean LOS was 39 days, and percent readmitted was 31.25%. For the years 2006-2010, the observed mean LOS was 15 days, and percent readmitted was 16%.

Plotting ROC curves using readmission and LOS showed most of the diagnoses area under the curve as between 0.412 and 0.563. Results of area under the curve for a selected few diagnoses are shown in table 1.2. The selected few diagnoses with area under the curve are: depressive disorders NOS, 0.412(95% CI 0.3658-0.45886); major depressive disorders, 0.4340(95% CI 0.40853-0.45947); bipolar disorders, 0.4987(95% CI

| Diagnosis | 2000-2005 | | | | | 2006-2010 | | | | | | Readm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | % Readmitted | Mean LOS | Median LOS | Maximum | n | % Readmitted | Mean LOS | Median LOS | Maximum | LOS P | P |
| Depressive DO NOS | 446 | 15.70 | 6.94 | 5.68 | 83.8 | 467 | 14.35 | 6.67 | 6.31 | 26.0 | 0.482 | 0.569 |
| PTSD | 109 | 31.19 | 11.50 | 7.73 | 145.0 | 60 | 20.00 | 7.67 | 6.75 | 28.3 | 0.072 | 0.119 |
| Major Depressive DO | 1533 | 21.20 | 7.45 | 6.11 | 61.9 | 955 | 22.62 | 7.94 | 6.83 | 55.6 | 0.023 | 0.405 |
| Bipolar DO | 473 | 29.81 | 10.70 | 8.46 | 83.8 | 286 | 31.12 | 10.14 | 7.78 | 63.1 | 0.404 | 0.704 |
| Schizophrenia Disorders | 89 | 41.57 | 17.76 | 9.82 | 297.0 | 35 | 34.29 | 13.54 | 8.88 | 53.5 | 0.470 | 0.459 |
| Psychosis NOS | 117 | 29.06 | 11.29 | 10.05 | 53.7 | 84 | 27.38 | 9.81 | 8.32 | 25.9 | 0.160 | 0.796 |
| Substance Abuse | 129 | 10.85 | 5.99 | 5.01 | 61.8 | 50 | 2.00 | 5.62 | 5.16 | 14.8 | 0.663 | 0.056 |
| Neurodevelopmental DO | 78 | 26.92 | 10.53 | 7.60 | 42.7 | 9 | 11.11 | 7.43 | 7.54 | 12.8 | 0.280 | 0.307 |
| Conduct – Oppositional DO | 54 | 16.67 | 9.24 | 6.36 | 123.1 | 23 | 21.74 | 7.57 | 6.90 | 13.8 | 0.638 | 0.603 |
| Eating Disorders | 32 | 31.25 | 12.30 | 11.17 | 39.9 | 25 | 16.00 | 15.45 | 7.91 | 72.8 | 0.379 | 0.191 |
| ADD | 120 | 27.50 | 8.16 | 6.88 | 74.7 | 43 | 11.63 | 6.85 | 5.97 | 17.0 | 0.286 | 0.035 |
| Anxiety DO | 214 | 20.56 | 6.77 | 5.74 | 84.2 | 105 | 20.00 | 6.83 | 6.01 | 20.8 | 0.936 | 0.907 |
| Mood DO | 348 | 23.28 | 8.18 | 6.88 | 65.9 | 915 | 24.92 | 10.25 | 8.02 | 105.8 | <0.001 | 0.545 |
| Other Disorders | 159 | 16.98 | 9.56 | 6.52 | 80.2 | 48 | 18.75 | 7.76 | 6.52 | 28.8 | 0.286 | 0.778 |
| Total Readmitted (%) | | 22.56 | | | | | 22.32 | | | | 0.226 | 0.811 |

**Table 1.1**: Length of Stay (Number of Days) for Years 2000-2005 and 2006-2010.
**Note:** Minimum Length of Stay was 1 day for both year categories for all diseases except Schizophrenia where minimum was 3 days in 2000-2005 and 2 days in 2006-2010.

| Disease | Length of Hospital Stay in Days | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1-7 days | 8-14 days | 15-21 days | 22-28 days | 29-35 days | Area Under Curve | 95% CI |
| **Depressive DO NOS** | | | | | | 0.4123 | (0.3658, 0.4589) |
| Sensitivity (%) | 56.59 | 91.47 | 97.67 | 99.22 | 99.22 | | |
| Specificity (%) | 26.18 | 4.43 | 1.25 | 0.69 | 0.55 | | |
| Correctly Specified (%) | 30.79 | 17.63 | 15.86 | 15.63 | 15.51 | | |
| **Major Depressive DO** | | | | | | 0.4340 | (0.4085, 0.4595) |
| Sensitivity (%) | 55.53 | 89.35 | 96.45 | 98.33 | 98.96 | | |
| Specificity (%) | 32.03 | 6.07 | 1.64 | 0.57 | 0.28 | | |
| Correctly Specified (%) | 37.05 | 23.85 | 21.89 | 21.44 | 21.36 | | |
| **Bipolar Disorders** | | | | | | 0.4987 | (0.4541, 0.5434) |
| Sensitivity (%) | 45.55 | 83.25 | 93.72 | 97.38 | 98.95 | | |
| Specificity (%) | 54.03 | 16.10 | 8.05 | 4.87 | 2.75 | | |
| Correctly Specified (%) | 51.58 | 35.44 | 32.73 | 31.52 | 30.47 | | |
| **Schizophrenia DO** | | | | | | 0.5633 | (0.4617, 0.6649) |
| Sensitivity (%) | 47.73 | 77.27 | 90.91 | 90.91 | 95.45 | | |
| Specificity (%) | 58.21 | 35.82 | 20.90 | 14.93 | 10.45 | | |
| Correctly Specified (%) | 54.05 | 52.25 | 48.65 | 45.05 | 44.14 | | |
| **Substance Use DO** | | | | | | 0.5423 | (0.4435, 0.6410) |
| Sensitivity (%) | 85.71 | 100.00 | 100.00 | | | | |
| Specificity (%) | 22.49 | 1.78 | 0.59 | | | | |
| Correctly Specified (%) | 27.32 | 9.29 | 8.20 | | | | |

**Table 1.2:** Length of Stay as Predictor of Readmission ROC Curves 1999-2010.
*Area includes the 0.5 no difference line.

0.45408-0.54337); schizophrenia disorders, 0.5633(95% CI 0.44353-0.64100); and substance use disorders, 0.5423(95% CI 0.44353-0.64100). For all diagnoses, the 1-7 day hospital LOS category had higher percentages of patients correctly specified compared to the other LOS categories (Table 1.2). The eating disorders diagnoses had large areas under the curve for all readmission categories compared, which were readmission within 30, 90, 180, and 365 days (Figure 1.1). The areas under the curve were 0.8375 (95% CI 0.76400-0.91100), 0.8375 (95% CI 0.76400-0.91100), 0.7763 (95% CI 0.66446-0.88818), and 0.7912 (95% CI 0.68455-0.89776) respectively (Table 1.3). Correctly specified percentages for sensitivity and specificity were also higher for eating disorders than any other diagnosis (Tables 1.2 and 1.3). Receiver operating characteristics (ROC) for eating disorders are shown in figure 1.1. According to these results, we cannot correctly predict readmission for most diagnoses based on length of stay. The group of eating disorders however has areas under the curve which are higher than 0.75, suggesting that we may be able to predict the readmission of pediatric patients with eating disorders within one year of discharge if we know the length of stay.

## Discussion

Hospital readmissions for all patients cannot be prevented, but there are some readmissions that are unnecessary and could be avoided [19,20]. Those readmissions that could be avoided are considered a waste of Medicare spending, which is approximately $15 billion annually [19,21]. The Affordable Care Act (ACA) places an emphasis on reducing readmissions and eliminating waste in Medicare spending and will reduce Medicare payments to hospitals with a high volume of readmissions [19,20]. The high volumes of readmissions are the readmissions within a short period of time after discharge, usually characterized as readmissions within 30 days of discharge [21]. Any discussions of reducing readmission and cost of care should involve investigation of length of stay. Such discussions are particularly important, and challenging in cases such as dealing with eating disorders, where our results show that fewer days in hospital or shorter length of stay may predict readmission.

In this study, there was no observed significant change in percent of patients readmitted. Within one year of discharge, the observed readmissions were 22.56% for the years 2000-2005 and 22.32% for the years 2006-2010 (Table 1.1). Although not statistically significant, the results in this study show a general trend of reduction of length of stay (Table 1.1). At a time when there is much emphasis on reducing cost, it is questionable whether providers may discharge patients early to decrease length of stay and therefore cost of care.

One of the ways that ACA seeks to reduce the readmissions is by the financial incentive. Starting in the 2012 fiscal year, ACA was to begin evaluating Medicare payments using a 30-day readmission rate index. Those hospitals that perform poorly were to receive a 1 percent reduction in reimbursements for the first year and continued unsatisfactory performance would give these hospitals a 3 percent reduction in reimbursement by the third year [20]. The financial penalties would expand to additional conditions by the year 2015; however, they were to first apply to three conditions of heart failure, pneumonia, and acute myocardial infarction [22]. ACA will require the Department of Health and Human Services to offer quality improvement programs as a way to support hospitals and will offer assistance to community-based organizations that team up with failing hospitals to identify ways to reduce readmissions [22]. It is not clear whether such a push by ACA will lead to additional reduction of length of hospital stay.

## ROC Curves

AUC for all categories of readmission for most diagnoses was less than 0.75 (Table 1.2). In this case, such AUC suggests that LOS was not a predictor of readmission for those disorders. For eating disorders, AUC was above 0.75 for all the readmission categories, namely 30, 90, 180, and 365 days after discharge (Table 1.3). Such high AUC suggests that for eating disorders, LOS may indeed be used to predict readmission. The results show a small sample of eating disorders of only n=32 for the years 2000-2005, and n=25 for the years 2006-2010. The small sample is likely because eating disorders are rare, and difficult to treat. With small sample sizes, there are possibilities of results being skewed. It is possible that the results could be different if the eating disorders sample was larger.

## Resource Use

Hospital length of stay can be tied to several resources which may include but is not limited to cost of care [4,6] and beds in psychiatric

| Disease | Hospital Length of Stay in Days | | | | | | |
|---|---|---|---|---|---|---|---|
| Eating Disorders | 1-7 days | 8-14 days | 15-21 days | 22-28 days | 29-35 days | Area Under Curve | 95% CI |
| **30 days of discharge** | | | | | | 0.8375 | (0.7640, 0.9110)* |
| Sensitivity (%) | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | | |
| Specificity (%) | 67.50 | 45.00 | 20.00 | 17.50 | 12.50 | | |
| Correctly Specified (%) | 72.92 | 54.17 | 33.33 | 31.25 | 27.08 | | |
| **90 days of discharge** | | | | | | 0.8375 | (0.7640, 0.9110)* |
| Sensitivity (%) | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | | |
| Specificity (%) | 67.50 | 45.00 | 20.00 | 17.50 | 12.50 | | |
| Correctly Specified (%) | 72.92 | 54.17 | 33.33 | 31.25 | 27.08 | | |
| **180 days of discharge** | | | | | | 0.7763 | (0.6645, 0.8882)* |
| Sensitivity (%) | 80.00 | 100.00 | 100.00 | 100.00 | 100.00 | | |
| Specificity (%) | 65.79 | 47.37 | 21.05 | 18.42 | 13.16 | | |
| Correctly Specified (%) | 68.75 | 58.33 | 37.50 | 35.42 | 31.25 | | |
| **365 days of discharge** | | | | | | 0.7912 | (0.6846, 0.8978)* |
| Sensitivity (%) | 81.82 | 100.00 | 100.00 | 100.00 | 100.00 | | |
| Specificity (%) | 67.57 | 48.65 | 21.62 | 18.92 | 13.51 | | |
| Correctly Specified (%) | 70.83 | 60.42 | 39.58 | 37.50 | 33.33 | | |

**Table 1.3**: Length of Stay as Predictor of Readmission for Eating Disorders ROC curves 1999-2010.
*Area includes the 0.5 no difference line

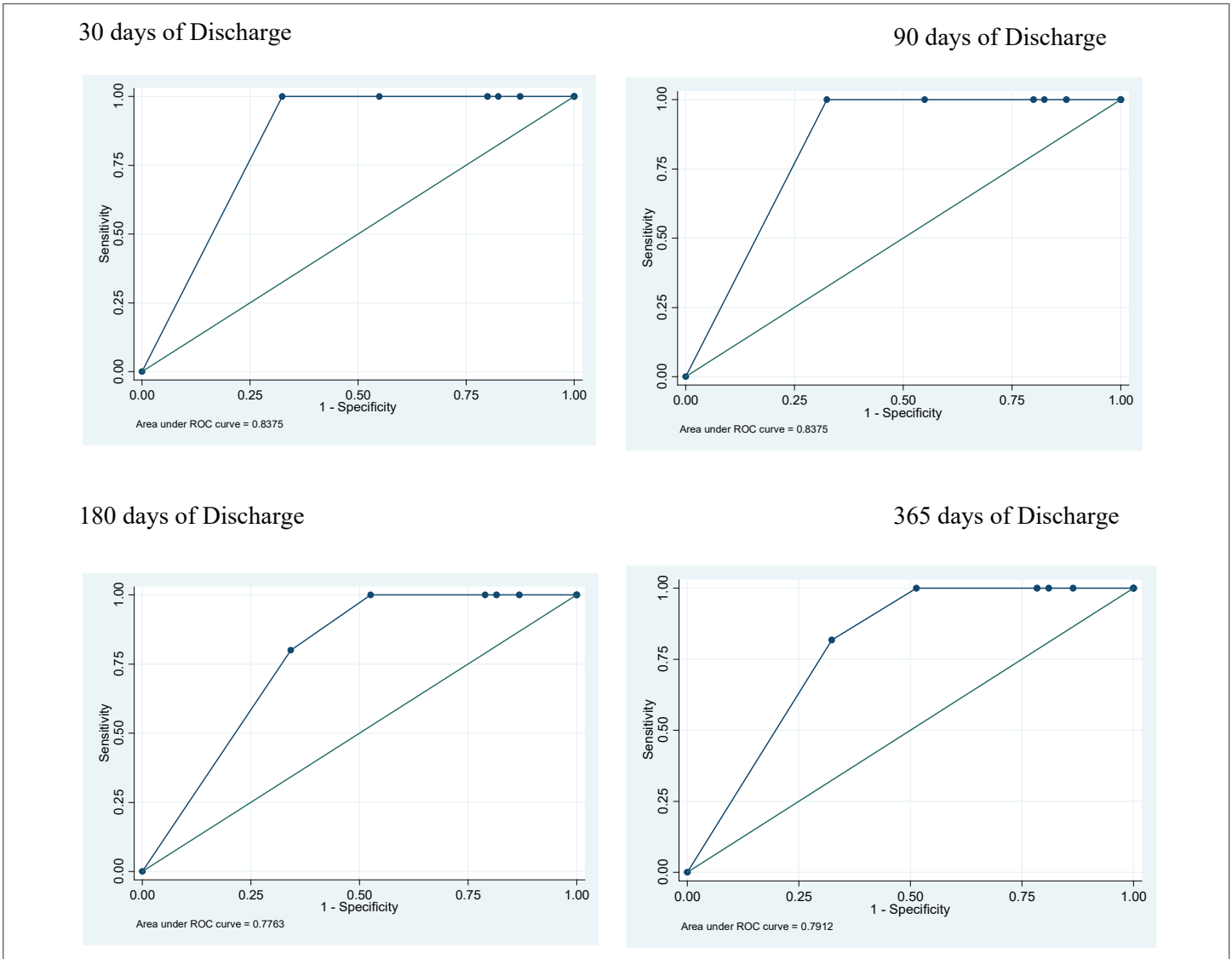


**Figure 1:** ROC Curves of Eating Disorders for the First 35 Days of Hospital Stay Measured at 1-7, 8-14, 15-21, 22-28, and 29-35 Days and for Readmission within 365 Days of Discharge.

hospitals [7,23]. Research shows that in some cases, it is difficult to know what condition comes first, such as a case where investigators report that onset of anxiety disorder was likely to come before substance use disorder [24]. In such cases, the process of estimating length of stay for a particular condition or determining resource use such as cost or unanticipated medical and mental health comorbidities [25] is complicated. In this study, we have only investigated primary diagnosis at time of admission. The findings of how length of stay is associated with readmission could change if there were knowledge of how much longer patients actually stay as inpatients when there is a dual diagnosis or comorbid illness. When the length of stay changes with dual diagnosis or comorbid illness, it is possible that resource use estimations of inpatient care could change as well. Additional research is needed to understand how dual and comorbid diagnoses interact to affect hospital length of stay, and readmission of the children with psychiatric illness.

Some cost savings have been observed by investigators from Assertive Community Treatment Services (ACT). ACTs are mobile clinics available 24 hours a day and 7 days a week and are staffed by a diversity of experts including but not limited to psychiatrists, psychologists, and social workers. They offer services to those individuals in the community with severe psychiatric illness and who use a lot of inpatient care [26,27]. Research of ACTs targeting veterans has defined the population using ACT services as those patients who have more than 30 inpatient mental health bed days or greater than three psychiatric inpatient experiences within the last 12 months. Also noted is that Medicaid, the largest payer of these services, does not pay for ACT services for the nonelderly adults. ACT services are said to save money because they limit inpatient days for those who are frequent psychiatric inpatient users [27]. There is no indication so far that ACT services have been tried for pediatric psychiatric patients. ACT would be very good to do as a cohort study and not wait until patients receive three or more inpatient experiences but are enrolled as soon as symptoms are observed. It is possible that cost savings may be observed with early intervention among pediatric patients. It is also possible that hospital length of stay days may be reduced but still avoids the repetitive readmissions if use of ACT is adopted among pediatric psychiatric inpatients.

## Strengths and Limitations

The biggest strength with this study is the use of the large data set that covers 11 years of clinical data. The many years of clinical data were vital to exploring how the hospital length of stay has changed over the years. These data were all from one facility in one state and although there could be a benefit of uniform data entry, it is difficult to generalize findings from this study to all psychiatric academic hospitals in different states. The focus on this research was with children or adolescents primary diagnoses at the time of admission. In psychiatry, however, it is possible that an individual is admitted as inpatient with one diagnosis but receives a different diagnosis while an inpatient or at discharge. Interaction of comorbid diagnosis was not investigated and could change any findings.

## Conclusion

A comparison of different years in this research showed that the maximum number of days of inpatient stay for children and adolescents with psychiatric problems decreased. Although the reduction of the observed maximum length of stay was high, there were only a few increases or decreases in readmission status among children and adolescents with different psychiatric problems. Eating disorders were an exception where the fewer number of days of inpatient stay highly predicted readmission of the patients. These results showed that regardless of the year, almost one quarter of patients still get readmitted and may suggest that some factors other than number of days of hospital stay may be responsible for readmission. Overall, there was no observed statistical significance in change in hospital length of stay and readmission between the years 2000-2005 and 2006-2010. Additional investigation of other variables such as treatment practices of inpatient children and adolescents is suggested to completely understand why children and adolescents get readmitted. The most important finding in this study is that research of psychiatric illness among children and adolescents that combines all psychiatric diagnoses together may not produce valid generalizable results. There are different characteristics for different diagnoses and possibly different predictors of readmission for the individual diagnoses. Researchers may get better results by taking each diagnosis independently. The other finding is the length of hospital stay has little to do with predicting readmission for most psychiatric disorders among pediatric patients.

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**Citation:** Kagabo R, Hashibe M, Kim J, Kleinschmit K, Clark C, et al. (2017) The Association between Length of Hospital Stay and Readmission for Pediatric Psychiatric Patient. Psychiatry Ment Health 2(1): doi http://dx.doi.org/10.16966/2474-7769.116

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