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ORIGINAL ARTICLE

Inpatient Stroke Rehabilitation Lengths of Stay in Canada Derived From the National Rehabilitation Reporting System, 2008 and 2009

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Abstract

Objective: To determine rehabilitation length of stay (LOS) for patients with stroke in Canada, and to evaluate which factors contribute to variations in LOS.

Design: A retrospective cohort study of Canadians rehabilitating from stroke using medical, functional, and sociodemographic variables extracted from the Canadian Institute for Health Information's National Rehabilitation Reporting System.

Setting: Canadian rehabilitation hospitals providing stroke rehabilitation services.

Participants: Patients with stroke (N = 11,983) admitted to rehabilitation hospitals from January 2008 through December 2009.

Interventions: None.

Main Outcome Measures: Rehabilitation LOSs were calculated nationally and regionally. Regression models incorporating sociodemographic and clinical measures were constructed to test their effect on LOS.

Results: The median stroke rehabilitation LOSs was 35 days (quartiles: 20d, 54d). LOSs varied regionally within Canada. A multivariable regression model including age, FIM motor function scores at admission, and geographic region explained 20% of the variation in LOSs. Modeling these data using a Function-Related Groups case-mix model explained 16% of the variation in LOSs.

Conclusions: FIM motor function scores at admission along with age and geographic region best predicted rehabilitation LOS. These variables explained 20% of the variation in LOSs. Despite regional differences in LOSs, patient characteristics were similar between regions. Other nonpatient factors not captured in these data may contribute to a greater extent in determining stroke rehabilitation LOS.

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Stroke rehabilitation length of stay (LOS) has important practical implications for patients recovering from stroke. LOS estimates allow patients, families, and clinicians to predict when patients might return to their community. From an administrative perspective, LOS can be used to estimate inpatient rehabilitation costs.[1]

Estimating stroke rehabilitation LOS is problematic because it is influenced by factors as diverse as rehabilitation team composition,[2] health care funding models,[3] discharge destination,[4] and patient functional capacities.[5] LOSs vary considerably by country (reported as 17d in the United States,[6] 35d in Canada,[7] 75d in England[8]). In Europe, "early supported discharge" has been shown to reduce LOS by 7 days without adverse effects.[9] Service providers generally feel pressure to reduce LOSs, but shorter LOSs are not universally regarded as positive. For some patients (eg, the elderly), some authors feel that a shorter LOS may reflect bias, premature discharge, and nonoptimal stroke rehabilitation.[10]

Currently, efforts are underway to develop benchmarks for stroke rehabilitation LOSs in Canada.[7,11] This study hopes to add to this effort by describing and modeling Canadian stroke rehabilitation LOSs nationally. The objectives of this study are to descriptively summarize current stroke rehabilitation LOSs in Canada as well as to model patient-specific factors that are

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important influences on individual stroke rehabilitation LOSs. Prior studies have shown that patient factors that one might suppose would be important in determining LOS (eg, medical comorbidities[12]) are not. Instead, LOS has been shown to a large extent to be influenced by measures of motor functional independence.[13] These findings are retested in this study using a large Canadian sample.

Methods

This retrospective review of Canadian stroke rehabilitation admissions (2008 and 2009) includes patients 18 years or older who were admitted to a rehabilitation unit for 3 or more days for stroke rehabilitation. Choosing which variables to model as possible influences on stroke rehabilitation LOS was based on a MEDLINE search of the English language literature that satisfied the OvidSP MeSH search terms *cerebrovascular disorders* inclusively and *length of stay* as a focus. This resulted in 208 articles. From these, 57 articles were considered relevant, and they contained 80 variables that had previously been studied. These variables varied broadly from specific measures such as knee extension force[14] to general administrative factors such as stroke care team effectiveness.[2]

Generally, the variables could be grouped into 1 of 6 categories: sociodemographics, acute stroke events, medical complications and comorbidities, patient function, therapy, and administrative variables. Conveniently, in Canada, the National Rehabilitation Reporting System (NRS) dataset collects many of these types of variables. The NRS was piloted in 1995, and by 2009 it was collecting information from 99 facilities across Canada with standardized reporting forms and coding schemes.[15,16] These data are gathered as part of routine admission and discharge procedures in participating facilities. The NRS contains detailed patient sociodemographic, functional, and medical information. Acute stroke event details are less represented in the NRS. For example, specific details relating to the volume of the stroke lesion are not recorded. Administrative and therapy-specific intervention variables are also less well represented, so these were not analyzed in this study.

After obtaining ethics approval from the University of British Columbia Clinical Research Ethics Board and project approval from the Canadian Institute of Health Information, a dataset containing 12,155 observations was extracted from the NRS. This dataset was trimmed to 11,983 observations (36 observations had LOS <3d, 5 observations had age <18y, 131 observations were missing FIM instrument patient function scores). These 11,983 observations were used in the analysis.

Statistical analysis

Statistical analyses were performed using SAS 9.3 for Windows.[a] No data were imputed. Because LOS data were skewed, they were transformed using their natural logarithm. No other data were transformed. Outliers were not excluded from the analysis.

List of abbreviations:

FIM-FRG	**FIM—Function-Related Groups**
ICD-10 CA	***International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada***
LOS	**length of stay**
NRS	**National Rehabilitation Reporting System**

After calculating descriptive statistics for the entire dataset, univariable analyses were performed on each variable to assess its effect on LOS. Impacts on LOS by categorical variables were assessed using the Kruskal-Wallis test. Continuous variables were tested using regression after ensuring that they satisfied requirements of homoscedasticity and normality. This was done using histograms, plots of the residuals, and the Shapiro-Wilk test of normality. To address negative skew in LOS values, they were transformed using their natural logarithm before applying parametric tests. Health comorbidity data are recorded in the NRS using *International Statistical Classification of Diseases and Related Health Problems, 10th Revision, Canada* (ICD-10 CA) codes.[17] The NRS records up to 15 health comorbidities at admission, and up to 15 health conditions that are diagnosed during rehabilitation. Health comorbidities were assessed by number using regression and by type using Kruskal-Wallis. Assessing by comorbidity type involved analyzing these data grouped by ICD-10 CA subcategory[17] as well as testing for specific health conditions that had clinical plausibility in influencing LOS. A list of conditions including select stroke determinants, stroke sequelae, mental health disorders, addictions, musculoskeletal disorders, and malignancies were tested. This list was constructed based on a literature search of previously studied health comorbidities that may influence LOS as well as on a survey of a group of local stroke physiatrists for their impression of relevant health comorbidities.

With the use of backward elimination, a multivariable regression model was built from the results of these univariable analyses. Variables with significant effect on LOS by univariable modeling were included. Variables were eliminated from the model if they did not reach significance in the multivariable model or if removing them did not reduce the adjusted coefficient of determination for the model by more than .01. Interactions between variables were assessed by plotting the residuals of the pairwise products of the variables.[18] Multicollinearity was assessed using the variance inflation factor. Normality and homoscedasticity were assessed using histograms, the Shapiro-Wilk test of normality, and plots of the residuals. In each case, the model was satisfactory.

Finally, some regions in Canada use the FIM—Function-Related Groups (FIM-FRG) case-mix model developed by Stineman et al[13] to estimate LOS.[7] The FIM-FRG model allows categorization of patients into 1 of 9 FIM-FRG case-mix groups based on an algorithm that considers FIM motor scores, age, and FIM cognitive scores at admission.[13] FIM-FRG case-mix model classifications were computed for patients in the NRS dataset, and the association of FIM-FRG to LOS was modeled using regression. This allowed for comparison of the fitness of an existing model used for setting LOS benchmarks, with the multivariable model developed directly from the NRS dataset.

Results

The median LOS was 35 days, the minimum was censored at 3 days, the maximum was 548 days, and the interquartile range was 34 days. The median age of patients admitted for stroke rehabilitation in Canada was 72 years; 55% were male. Ninety-five percent were living in the community at the time of admission, 66% were living with family, and 50% of patients were receiving some sort of informal support at home before being admitted for rehabilitation. The median admission FIM total function score was 77/126. The median FIM motor and cognitive function scores at admission were 51/91 and 26/35, respectively. Right-body paresis