Disability Impacts Length of Stay in General Internal Medicine Patients

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BACKGROUND: Disability is prevalent among patients treated in Internal Medicine (IM), but its impact on length of inpatient stay (LOS) is unknown. Current systems of patient management and resource allocation are disease-focused with scant attention paid to functional impairment. Earlier studies in selected cohorts suggest that disability prolongs LOS.

OBJECTIVE: To investigate the relationship of disability with LOS in IM, controlling for comorbidity.

DESIGN: Prospective cohort study.

PATIENTS: We charted 448 patients from an IM team admitted between 2008 and 2012 for sociodemographic, disease, biochemical and functional characteristics. Each IM team is on duty for one month annually, and patients were hence recruited for one month each year.

MAIN MEASURES: Disability was measured using the Functional Independence Measure (FIM) recorded at discharge. Comorbidity was measured using the Charlson Comorbidity Index (CCI).

KEY RESULTS: Of the 448 patients, 57.4 % were male with mean age 68.6 years. The mean LOS was 9.58 days. The mean motor and cognitive FIM scores were 57.1 and 25.7, respectively. The mean CCI score was 2.69. Thirty-four percent had major social issues impacting discharge plans. The five most common diagnoses for admission were pneumonia (8.9 %), urinary tract infection (7.8 %), cellulitis (7.6 %), heart failure (7.1 %) and falls (6.0 %). Both cognitive and motor FIM scores were negatively correlated with longer LOS ($P < 0.001$). On multivariate analysis, variables independently associated with longer LOS included the motor FIM score ($P < 0.001$), presence of social issues such as caregiver unavailability ($P < 0.001$), non-realistic patient expectations ($P = 0.001$) and administrative issues impeding discharge ($P = 0.016$).

CONCLUSION: Disability predicts LOS in IM patients, and thus their comprehensive care should involve functional assessment. As social and administrative factors were also independently associated with LOS, there is a need to involve social workers and administrators in a multidisciplinary approach towards optimizing LOS.

KEY WORDS: internal medicine; hospital medicine; disability; length of stay (LOS).

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INTRODUCTION

The length of inpatient stay (LOS) is a key marker of efficiency in hospital systems.¹ It represents the cost of healthcare for both hospitals and patients with unnecessary days spent in hospital translating to increased cost burdens.^{1–3} Since many governments subsidize a substantial part of public healthcare, increased LOS also translates to higher public costs.^{4,5} In addition to financial factors, prolonged LOS may predispose patients to hospital-acquired infections and iatrogenic injuries, which themselves further prolong LOS.^{1,3}

While there are health and financial disincentives for prolonged LOS, this has to be balanced against patient safety and quality of clinical care. Adequate time is needed to evaluate patients thoroughly, perform relevant investigations and institute appropriate treatment.⁶ Driving down the LOS may increase the readmission rate if patients are discharged before they are medically stable.

There are five main factors that influence LOS in the medical literature: demographic factors, disease severity, comorbidities and complications, type of intervention and social issues. Demographic factors such as age correlate to increased LOS, due to greater comorbidities and social issues.^{3,7–9} Disease severity specific to a health condition such as stroke correlates with increased LOS.³ Increased comorbidity burden has been shown to prolong LOS in patients with stroke, bacteremia and heart failure.^{3,10,11} Conversely, other interventions have been shown to decrease LOS. For example, the switching from parenteral to oral antibiotics in pneumonia patients⁸ and the availability of physiotherapy on Sundays in knee arthroplasty patients¹². Although social and family support are not often considered a part of medical decision making, they play a big role in discharge planning and have been associated

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with LOS issues.⁷ Interventions, including the implementation of family support coordinators, have helped decrease LOS and costs in intensive care patients.¹³

Although there are many reported factors impacting on LOS in general internal medicine patients, there is scant data on the impact of disability and social issues. Most studies report associations between disability and LOS for selected diagnoses, or in cohorts undergoing rehabilitation rather than general patients in the internal medicine wards.^{14–16} For example, Bohannon and Cooper demonstrated that LOS and function at discharge were influenced favourably by a higher level of function on admission in selected stroke patients.¹⁴ Also, Greenberg et al. observed that geriatric patients, who were more disabled, had longer LOS compared to general medicine patients.¹⁵ The purpose of this study was to evaluate the relationships between disability as measured with the Functional Independence Measure (FIM) at discharge and LOS in internal medicine patients. This is essential, as Internal Medicine (IM) patients often form the largest cohort of patients in a tertiary general hospital, including all the public hospitals in our country. In addition, we explored whether any association between disability and length of hospital stay for internal medicine patients was independent of known covariates including age, comorbidities and social issues.

METHODS

This study was approved by the Institutional Review Board (IRB) of the Singapore General Hospital (2012/885/D).

Setting and Data Collection

We recruited all patients admitted under a single medical team from 2008 to 2012 ($n=460$) to the Department of Internal Medicine at the Singapore General Hospital, a large tertiary academic hospital. This team accepted patients for a month in each year of the 5 years of this study.

Measurements

Variables were collected in several categories. The variables were chosen based on prior reported literature, as well as local social characteristics that we believed could impact on LOS.

Demographic variables that were charted include age, gender and ethnicity. Disease related variables included both primary and secondary diagnoses and haematological and biochemical measures.^{17,18} Longer LOS has been associated with increased severity of social problems.^{7,19} Social issues were also documented if these interfered with the team's plan for discharge. The social issues were categorized into the following because of their prevalence on our clinical practice: caregiver unavailability, non-

compliance, psychological issues/unrealistic expectations, financial issues and administrative issues.

The social issues were deemed to have affected LOS if it interfered with the team's plan for discharge. A common scenario would be for a patient deemed medically fit for discharge but requiring a caregiver to assist with activities of daily living (ADLs). Such a patient may stay longer in hospital if his family is unable to cope and is waiting for a domestic helper to arrive from abroad. These patients may also require nursing home care, which can prolong LOS due to a shortage of nursing home vacancies in Singapore. Non-compliance issues include refusal to comply with medical treatment in the hospital or in the community, this necessitating a prolonged time of counselling and advice, together with elucidating reasons for noncompliance. Unrealistic expectations include demand to see multiple specialists or performing multiple diagnostic tests due to over-anxiety or unrealistic demands that prolong LOS. Financial issues refer to various difficulties for discharge due to financial reasons. These include the need to obtain funds for wheelchairs or walk aids prior to discharge, or the arrangement for the need for social work intervention for bill payment. Administrative issues refer to delays in performing essential diagnostic or laboratory procedures; for example, a wait-time for computed tomography (CT) or magnetic resonance imaging (MRI) across a weekend. This also refers to delays in consults due to the non-availability of a specialist across a public holiday. Comorbidities have also been correlated to the LOS.¹¹ The Charlson Comorbidity Index (CCI) was used as the measure of comorbidity burden. The CCI assesses comorbidity level through a weighted score that considers the number and severity of 19 predefined conditions. Each condition has an associated weight based on the adjusted risk of 1-year mortality. The overall score reflects the cumulative disease burden.²⁰ Currently, it is the most frequently used scoring system by clinicians in evaluating comorbidity burden.²¹

We charted the Functional Independence Measure (FIM) as our primary disability measure in this study. It is a common internationally used outcome measure in rehabilitation cohorts for prognostication and funding, especially in North America, Australia and Japan.^{22–24} The FIM consists of an 18-item scale that measures the severity of disability in terms of burden of care. It charts motor parameters for areas of self-care, sphincter control, transfers, and locomotion, as well as cognitive parameters for communication and social cognition. Patients are rated on a scale of 1 to 7 for each area assessed, with 1 being complete dependence and 7 being complete independence. Hence, lower FIM scores represent a greater dependence. It ranges from 18 (total dependence) to 126 (full independence).²² All raters were credentialed in using the FIM. The psychometric properties of the FIM compare favorably to most standardized health measures used in medical practice.

Both the summated total FIM and its motor and cognitive subscales possess excellent internal consistency.²⁵ The FIM has good content and construct validity, sensitivity and inter-rater reliability for the measurement of general functional ability across a wide range of disease conditions. It is valid as a disability scale, with good correlation between the FIM and other disability scales.^{22,23,26} FIM scores in our study were measured at discharge from the inpatient general medical wards, when medically stable. This is because acute illness obscures accurate assessments of the underlying disability due to a rapidly changing clinical course. We also wanted to determine the IM cohort's disability burden on acute hospital discharge for future interventions such as rehabilitation.

Statistical Approach

Sample size calculation was done using Stata V11.2 (Stata Corp, College Station, Tx, USA). With our data set of 460 patients, there was 90 % power to detect a Pearson's correlation as small as 0.15 between LOS and FIM score. Subsequent statistical analysis was performed with Statistical Package for Social Sciences (SPSS) version 17.0 (SPSS Inc., Chicago, IL, USA).

We removed patients with missing data; namely those without FIM scores and incomplete information about their social circumstances. The remaining 448 patients were subject to statistical analysis. The excluded data was not analysed, as it constituted only a small fraction of the cohort (2.6 %).

All descriptive statistics were reported as mean (standard deviation, SD) or median (Interquartile range, IQR). Pearson's correlation was used to assess the association between FIM and LOS. The association between LOS and specific variables was first determined using univariate linear regression. As the distribution of LOS data was positively skewed, log transformation for LOS was performed prior to analysis.

Variables were then simultaneously entered into a multivariate linear regression model in order to get an adjusted coefficient of motor and cognitive FIM in relation to LOS. Given the large Chinese majority in our population, ethnicity was analysed as a binary variable comparing Chinese with other ethnicities for the purpose of meaningful analysis. We included the following variables in the multivariate model: gender, age, ethnicity, motor FIM, cognitive FIM, CCI score, serum albumin, haemoglobin, serum creatinine, diagnosis of pneumonia, diagnosis of urinary tract infection, diagnosis of heart failure, diagnosis of fall, caregiver unavailability, non-compliance, presence of psychological issues, presence of financial issues and presence of administrative issues. Statistical significance was set at the conventional $P < 0.05$.

RESULTS

Of the 448 patients in our study, 57.4 % were male with a mean age of 68.6 (17.2) years. Three hundred and forty-five (77 %) were Chinese, 49 (10.9 %) were Malay, 43 (9.6 %) were Indian and 11 (2.5 %) were of other ethnicities. The mean LOS was 9.58 (12.3) days, with mean motor FIM of 57.1 (28.3), mean cognitive FIM of 25.7 (10.2) and a mean CCI of 2.69 (2.51). The mean serum albumin was 31.4 (8.51) g/dL, mean haemoglobin was 12.3(2.23) g/dL and mean serum creatinine was 131 (124) $\mu\text{mol/L}$. The five most common diagnoses were: pneumonia (8.9 %), urinary tract infection (7.8 %), cellulitis (7.6 %), heart failure (7.1 %) and falls (6.0 %). One hundred and fifty-one patients had major social issues impacting discharge, of which 85 experienced caregiver unavailability, 23 had issues with compliance to medical treatment, 56 had psychological issues/unrealistic expectations, 11 had financial issues and 35 had administrative issues (Table 1).

Length of stay was negatively correlated with both motor and cognitive FIM at -0.008 and -0.02 (both $P < 0.001$). Other significant variables that were correlated with longer LOS on bivariate analysis were higher CCI scores, older age, having a diagnosis of pneumonia or falls, as well as lower serum albumin and haemoglobin levels. Social issues that were significantly correlated with longer LOS were those of caregiver unavailability, psychological issues/unrealistic expectations and administrative issues (Table 2).

In the multivariate analysis, the factors independently associated with longer LOS were lower discharge motor FIM score, presence of a diagnosis of cellulitis, caregiver

Table 1. Descriptive Summary of the Study Population

Variables	Descriptive statistics
Mean (SD) LOS (days)	9.58 (12.3)
Median (IQR) LOS (days)	5 (3;11)
Females [n (%)]	191 (42.6)
Mean (SD) age (years)	68.6 (17.2)
Chinese ethnicity ([n (%)]	345 (77)
Malay ethnicity [n (%)]	49 (10.9)
Indian ethnicity [n (%)]	43 (9.6)
Other ethnicities ([n (%)]	11 (2.5)
Mean (SD) motor FIM	57.1 (28.3)
Mean (SD) cognitive FIM	25.7 (10.2)
Mean (SD) Charlson Comorbidity Index (CCI)	2.69 (2.51)
Mean (SD) serum albumin (g/L)	31.4 (8.51)
Mean (SD) haemoglobin (g/dL)	12.3 (2.23)
Mean (SD) serum creatinine ($\mu\text{mol/L}$)	131 (124)
Presence of diagnosis of Pneumonia [n (%)]	40 (8.9)
Presence of diagnosis of Urinary Tract Infection [n (%)]	35 (7.8)
Presence of Diagnosis of Cellulitis [n (%)]	34 (7.6)
Presence of diagnosis of Heart Failure [n (%)]	32 (7.1)
Presence of diagnosis of Fall [n (%)]	27 (6.0)
Presence of major social issues affecting discharge [n (%)]	151 (33.7 %)
Caregiver unavailability [n (%)]	85 (19.0)
Non-compliance [n (%)]	23 (5.1)
Psychological issues/unrealistic expectations [n (%)]	56 (12.5)
Financial issues [n (%)]	11 (2.5)
Administrative issues [n (%)]	35 (7.8)

Table 2. Linear Regression of Individual Variables with lg(Length Of Stay)

Variables	Unstandardized Coefficient, β (95 % CI)	P-value
Female (vs. Male)	-0.020 (-0.100, 0.060)	0.623
Age (years)	0.007 (0.004, 0.009)	< 0.001
Chinese (vs others)	0.122 (0.029, 0.215)	0.01
Motor FIM	-0.008 (-0.009, -0.007)	< 0.001
Cognitive FIM	-0.02 (-0.023, -0.017)	< 0.001
Charlson Comorbidity Index (CCI)	0.043 (0.028, 0.058)	< 0.001
Serum albumin (g/L)	-0.014 (-0.019, -0.009)	< 0.001
Hemoglobin (g/dL)	-0.032 (-0.050, -0.015)	< 0.001
Serum creatinine ($\mu\text{mol/L}$)	6.95e^{-5} (NV, NV)*	0.669
Presence of diagnosis of Pneumonia	0.286 (0.150, 0.422)	< 0.001
Presence of diagnosis of Urinary Tract Infection	0.128 (-0.018, 0.275)	0.086
Presence of diagnosis of Cellulitis	0.002 (-0.147, 0.151)	0.98
Presence of diagnosis of Heart Failure	-0.124 (-0.277, 0.028)	0.11
Presence of diagnosis of Fall	0.191 (0.026, 0.356)	0.023
Caregiver unavailability	0.396 (0.302, 0.490)	< 0.001
Non-compliance	0.112 (-0.066, 0.290)	0.218
Psychological issues/unrealistic expectations	0.207 (0.09, 0.325)	0.001
Financial issues	0.079 (-0.176, 0.333)	0.544
Administrative issues	0.458 (0.317, 0.598)	< 0.001

*NV: negligible value

unavailability the presence of psychological issues/unrealistic expectations and administrative issues (Table 3). The adjusted R^2 was 0.38, indicating that 38 % of the variability in LOS could be explained by our model.

Table 3. Multiple Linear Regression of Selected Variables and lg(Length Of Stay)

Variables	Unstandardized Coefficient, β (95 % CI)	P value
Female (vs. Male)	-0.030 (-0.103, 0.043)	0.417
Age (years)	-0.001 (-0.004, 0.001)	0.392
Chinese (vs others)	0.045 (-0.042, 0.133)	0.310
Motor FIM	-0.006 (-0.009, -0.004)	< 0.001
Cognitive FIM	<0.001 (-0.007, 0.007)	0.976
Charlson Comorbidity Index (CCI)	0.007 (-0.010, 0.023)	0.437
Serum albumin (g/L)	-0.004 (-0.009, < 0.001)	0.062
Hemoglobin (g/dL)	-0.012 (-0.029, 0.006)	0.189
Serum creatinine ($\mu\text{mol/L}$)	-3.07e^{-5} (< 0.001, < 0.001)	0.836
Presence of diagnosis of Pneumonia	0.113 (-0.017, 0.242)	0.088
Presence of diagnosis of Urinary Tract Infection	0.081 (-0.048, 0.209)	0.219
Presence of diagnosis of Cellulitis	0.159 (0.009, 0.308)	0.038
Presence of diagnosis of Heart Failure	-0.063 (-0.201, 0.076)	0.374
Presence of diagnosis of Fall	0.050 (-0.103, 0.204)	0.519
Caregiver unavailability	0.226 (0.122, 0.330)	<0.001
Non-compliance	0.033(-0.128, 0.194)	0.686
Psychological issues/unrealistic expectations	0.170 (0.067, 0.273)	0.001
Financial issues	-0.074(-0.301, 0.153)	0.521
Administrative issues	0.170 (0.031, 0.308)	0.016

Adjusted $R^2=0.383$; $F=13.6$, $df=19$, $P\text{ value}<0.001$

DISCUSSION

Our study suggests that lower motor FIM scores (greater functional impairment) are associated with longer LOS after controlling for comorbidity and a variety of known predictors. This is in line with the literature on associations of disability and LOS in rehabilitation or specific disease cohorts, and affirms our hypothesis that disability is associated with LOS in internal medicine patients. While both motor and cognitive FIM were strongly associated with LOS on univariate analysis, only motor FIM remained associated with LOS in the multivariate analysis, as motor FIM is a stronger predictor of LOS than cognitive FIM.²⁷

The presence of social issues, such as caregiver unavailability, psychological and administrative issues, were also significantly associated with longer LOS. This follows previous literature where LOS was longer in patients with psychosocial problems, caregiver unavailability or who faced administrative issues delaying discharge.^{7,19,28,29} We believe that this was similar in our institution, where patients with disabilities are more reliant on caregivers.

Higher comorbidity burden was positively correlated with longer LOS on univariate analysis. In other studies, Foraker et al. showed that patients with greater comorbidity burden, as defined by CCI scores greater than 2 points, had longer LOS compared to those with scores below 2 points. However, disability was not measured in their study and there was no direct documentation of the presence of social issues.¹¹ In our statistical analysis, comorbidity burden was no longer predictive when combined together with disability and other variables in the multivariate model. A possible reason for this may be that disability itself is a final manifestation of comorbidity. For example, patients with cardiovascular risk factors such as diabetes mellitus may be predisposed to stroke, which then results in functional impairment. On the other hand, comorbid patients who are not disabled are not subjected to the restrictions that disabled patients are. A patient with diabetes mellitus and heart failure who is not disabled would be able to function as a nondisabled individual, and hence not be reliant on caregivers.

Other variables significantly associated with longer LOS in our study were the diagnoses of pneumonia and fall, as well as lower serum albumin and haemoglobin levels. This is consistent with prior studies.^{17,18,30-32} Collins and colleagues found that post-operative pneumonia in general surgical patients was associated with increased LOS.³⁰ Hermann and colleagues found that patients with serum albumin level < 34 g/L had mean LOS of 14.1 ± 15.7 , in contrast with patients who had albumin levels ≥ 34 g/L who had mean LOS 9.61 ± 12.1 ($P<0.001$).¹⁸ Willems et al. demonstrated that elderly patients with postoperative anemia stayed longer, with an average of 10.7 days compared to those without postoperative anemia with an average of 7.5 days ($P=0.007$). Their study also showed that pst-

operative haemoglobin levels and LOS were inversely related.¹⁷

The implications of our findings are manifold. Firstly, disability should be assessed and documented for all internal medicine patients when assessing the LOS. A study conducted on Singapore patients correlated increased LOS with increased hospitalization costs.³³ Disability should also be considered in resource allocation and funding for internal medicine patients.

Secondly, inpatient rehabilitation programs should be targeted at patients with more significant disability as these may improve outcomes, shorten LOS and prevent rehospitalisation.³⁴ Thirdly, LOS is further affected by many medical and social factors, suggesting that disabled patients should be managed by a multidisciplinary team involving medical social workers to optimize LOS.

These predictive variables should also be addressed in optimizing LOS. Physicians should be cognizant of patients with social issues needing early referrals. Additionally, our results suggest that haemoglobin and albumin levels are low in severe illness where there is a need for prolonged treatment. Close communication should hence be maintained within the multidisciplinary team involving internal medicine physicians, the rehabilitation team, social workers and other healthcare workers in charge of the patient, as well as the patient and his/her caregivers. This will facilitate understanding and cooperation aimed at giving the patient the best outcome in the shortest duration of hospitalization possible.

Our study is unique because cohorts examining functional data are usually reported in well-defined patient groups rather than in non-specific cohorts like internal medicine, where patients frequently present with vague complaints, often with a background of multiple chronic conditions that contribute to an overall disease burden.¹⁶ However, there are several limitations in our study. Firstly, only patients from a single team were evaluated, limiting the generalizability of our results to an even larger inpatient internal medicine cohort. Secondly, patients were recruited for only 1 month every year. As there may be variations in the numbers and case mix of patients admitted in different months, this approach may have resulted in sampling bias.

The FIM has limitations including ceiling effects³⁵, especially with better functioning patients who constitute a large portion of our cohort. The FIM also does not measure participation limitations, which may impact more on the patient's ability to be independent of caregivers on discharge, such as the capacity to return to work or to prepare meals for themselves.

The CCI has limitations as well. Debilitating conditions such as epilepsy, arthritis, visual and hearing impairments that were commonly found in our cohort are not weighted in the CCI, a problem which has been highlighted in previous literature on elderly patients.³⁶

Future studies should be conducted on a larger scale involving more teams in internal medicine, or involve internal medicine departments from different hospitals. Studies could also investigate other outcomes of inpatient hospitalization, including readmission rate, which we were unable to do in our pilot study.

CONCLUSION

In conclusion, the results of our study are consistent with our hypothesis that greater disability is associated with longer LOS. Fair and appropriate allocation of healthcare resources should take the presence of disability into consideration. The comprehensive care of internal medicine patients should include assessment of function, complication prevention and triage for early rehabilitation. Close clinical integration by a multidisciplinary team should occur concurrently with acute medical treatment to optimize LOS.

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Conflict of Interest: The authors declare that they do not have a conflict of interest.

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