Original Article

Factors Affecting Unplanned Readmissions from Community Hospitals to Acute Hospitals: A Prospective Observational Study

Ian YO Leong,[1] *MBBS, FRCP Edin, FAMS*, Siew-Pang Chan,[2] *PhD (Hon), CSci, CMathMIMA*, Boon-Yeow Tan,[3] *MMed (Fam Med), MMed (Geriatrics), FCFP (S)*, Yih-Yiow Sitoh,[1] *MBBS, FRCP Edin, FAMS*, Yan-Hoon Ang,[4] *FRCP Edin, DGM, FAMS*, Reshma Merchant,[5] *MBChB (Edin), MRCP (UK), FAMS*, Kala Kanagasabai,[6] *MMed (Fam Med), DGM, MCFP (S)*, Patricia SY Lee,[7] *MBBS, MMed (Fam Med), GDGM*, Weng-Sun Pang,[4] *MMed (Int Med), FRCP Edin, FAMS*

Abstract

Introduction: While the readmission rate from community hospitals is known, the factors affecting it are not. Our aim was to determine the factors predicting unplanned readmissions from community hospitals (CHs) to acute hospitals (AHs). Materials and Methods: This was an observational prospective cohort study, involving 842 patients requiring post-acute rehabilitation in 2 CHs admitted from 3 AHs in Singapore. We studied the role of the Cumulative Illness Rating Scale (CIRS) organ impairment scores, the Mini-mental State Examination (MMSE) score, the Shah modified Barthel Index (BI) score, and the triceps skin fold thickness (TSFT) in predicting the rate of unplanned readmissions (UR), early unplanned readmissions (EUPR) and late unplanned readmissions (LUPR). We developed a clinical prediction rule to determine the risk of UR and EUPR. Results: The rates of EUPR and LUPR were 7.6% and 10.3% respectively. The factors that predicted UR were the CIRS-heart score, the CIRS-haemopoietic score, the CIRS-endocrine / metabolic score and the BI on admission. The MMSE was predictive of EUPR. The TSFT and CIRS-liver score were predictive of LUPR. Upon receiver operator characteristics analysis, the clinical prediction rules for the prediction of EUPR and UR had areas under the curve of 0.745 and 0.733 respectively. The likelihood ratios of the clinical prediction rules for EUPR and UR ranged from 0.42 to 5.69 and 0.34 to 3.16 respectively. Conclusions: Patients who have UR can be identified by the admission BI, the MMSE, the TSFT and CIRS scores in the cardiac, haemopoietic, liver and endocrine/metabolic systems.

Ann Acad Med Singapore 2009;38:113-20

Key words: Older persons, Post-acute care, Rehabilitation

Introduction

With the ageing population worldwide and the shortage of acute hospital beds, intermediate care is becoming an important aspect of the healthcare system.[1,2] Although there has been a myriad of studies and reviews comparing novel intermediate care systems and "usual care", little is known as to which patients would or would not benefit from a particular system of intermediate care.

Community hospitals will remain an important aspect of intermediate care by virtue of their scale and history. In Singapore, there are 650 community hospital beds.[3] There has been a number of studies describing the range of services available in community hospitals in the United Kingdom and these roles could well be replicated in Singapore.[4] Recently, there has been a randomised controlled trial from the United Kingdom, by Green and colleagues,[5] which demonstrated that patients receiving community hospital care were more independent at 6 months after discharge compared to their counterparts in wards for elderly people in the district hospital. An economic analysis, by O'Reilly and colleagues,[6] showed that community hospital care is similar in cost to that of district hospital care. However, there is little data as to the outcomes from community hospitals and the risk factors

[1] Department of Geriatric Medicine, Tan Tock Seng Hospital, Singapore
[2] Clinical Research Unit, Tan Tock Seng Hospital, Singapore
[3] St Luke's Hospital, Singapore
[4] Department of Geriatric Medicine, Alexandra Hospital, Singapore
[5] Department of Medicine, National University Hospital, Singapore
[6] Renci Hospital and Medicare Centre, Buangkok View, Singapore
[7] Ang Mo Kio-Thye Hua Kwan Hospital, Singapore
Address for Correspondence: Dr Ian Leong, Department of Geriatric Medicine, Tan Tock Seng Hospital, 11 Jalan Tan Tock Seng, Singapore 308433.
Email: ian_leong@ttsh.com.sg

for poor outcomes. Data on risk factors predicting outcomes such as mortality, readmission rates or rehabilitation efficiency among older medical patients are only available for patients admitted to acute hospitals.[7] Extrapolating this information to the community hospital setting could potentially be inappropriate as the acuity of illness is likely to be different.

The practical difficulty of this lack of knowledge is that we may have difficulty selecting appropriate patients for community hospital care, especially when there may be an issue of medical instability.[8] Transferring potentially unstable patients would have implications on the level of medical supervision required. It may also result in patients being readmitted to the acute hospital. Published reports of readmission rates range from 9.2% in Leicestershire[9] to 12.0% in Singapore.[10] Readmissions can be bothersome or even potentially dangerous when the distance between the acute hospital and community hospital is substantial and the wait in the emergency departments long.

Our intention was to study patients readmitted for medical reasons to an acute hospital after being transferred to a community hospital. We believe that readmissions would be a surrogate for medical instability, especially for patients who needed to be readmitted after a short stay in the community hospital. Our aim was therefore to study the medical, psychological and functional factors that are associated with readmissions from community hospitals to acute hospitals.

Patients and Methods

The study was approved by the institutional review board of the National Healthcare Group, Singapore. The study involved patients in 2 community hospitals with bed capacities of 140 and 200, admitted from 3 acute hospitals with bed capacities ranging from 400 to 1200, for post-acute care.

Definitions

Early unplanned readmission (EUPR) was defined as an unplanned readmission to the acute hospital because of medical reasons after a stay in the community hospital of 7 days or fewer. A late unplanned readmission (LUPR) was an unplanned readmission beyond 7 days. Unplanned readmissions (UR) were defined as all unplanned discharges, including EUPR and LUPR. Patients with planned discharges were those who completed their rehabilitation programme before they were discharged. These definitions were based on the index admission of the patient. The reason for choosing the cut-off of 7 days was that the rate of readmission at this point (12.0%) would provide an adequate pre-test probability for the development of clinically meaningful predictive models. Our analysis of the reasons for readmission (not shown) also demonstrated that the time to readmission was not different among the groups that had developed a new complication, where a pre-existing illness had become poorly controlled, or where pain was uncontrollable.

Protocol

This study is part of a larger study that evaluated patients admitted to community hospitals from acute hospitals for rehabilitation, examining the contribution of demographic, social, medical, cognitive and functional variables on outcomes like mortality, functional status and discharge placement.

Patients were considered eligible if they were 55 years or older, as our intention was to allow for studies of age effects on various outcomes. Patients who were being transferred for palliative care, respite care, convalescence, solely for training of caregivers, or solely to await placement into a long-term facility were excluded. Patients who were known to be on any social welfare schemes were also excluded. Patients who did not complete their stay in the community hospital, but were not readmitted to acute hospitals for medical reasons were excluded. As some patients had multiple readmissions during the study period, only data pertaining to the index admission were used.

Informed consent was taken on admission to the community hospital. Thereafter, information was collected from the next-of-kin and case records. The patient was also evaluated by the therapist and the research staff on admission to the community hospital. Most of the data were collected at one point. The functional data during the community hospital stay was collected on a weekly basis. In this study, we included only medical, psychological and functional data from their first admission within the period of the study. For all cases, the risk factors studied were of the index admission.

Risk Factors Affecting Unplanned Readmissions

The risk factors studied were those known to affect outcomes of elderly patients admitted to acute hospitals. These factors included demographic factors, measures of medical status, cognitive functioning, physical functioning and nutrition.

The medical status of the patient was evaluated using the organ specific severity grading on the Cumulative Illness Rating Scale for Geriatrics (CIRS).[11] This measures the severity of organ impairment for 14 different organ systems using a 0 (no impairment) to 4 (extremely severe) scoring. The organ systems evaluated were heart, vascular, haemopoietic, respiratory, upper gastrointestinal tract, lower gastrointestinal tract, liver, renal, genitourinary, musculoskeletal/integument, neurological, endocrine/

metabolic and eye/ear/nose/throat. A score of 1 is defined as "current mild problem or past significant problem". A score of 2 is defined as "moderate disability or morbidity/ requires 'first line' therapy". A score of 3 is defined as "severe/constant significant disability/uncontrollable chronic problems". A score of 4 is defined as "extremely severe/immediate treatment required/end organ failure/ severe impairment in function". The CIRS was scored based on the discharge medical data from the index admission of the acute hospital. For the purposes of statistical analysis, we collapsed the scores into 3 categories: scores of 0 to1 were classified as none/mild, a score of 2 was classified as moderate, and scores of 3 to 4 were classified as severe.

The functional status was evaluated using the Shah modified Bathel Index (BI),[12] which is scored from 0 to 100. A pre-morbid score was obtained based on reports by the relatives. This was standardised to all patients so as to diminish bias due to incorrect recall on the part of the patient and bias due to data collection from different sources. This was obtained by trained research assistants. An admission score was obtained within 24 hours of admission by the occupational therapist of the respective community hospital. Thereafter, patients were evaluated on a weekly basis till discharge.

The cognitive status of the patient was assessed using the Mini-mental State Examination (MMSE).[13] The Mini-mental state Examination was used as it is a well validated screening tool for cognitive impairment. Scores have also been shown to correlate with the severity of cognitive impairment, in diagnosis such as dementia. The nutritional status was evaluated with the triceps skin fold thickness (TSFT). The TSFT is a measure of fat content of the body and has been associated with mortality and adverse clinical events in geriatric rehabilitation patients.[14] These were assessed within 3 days of admission into the community hospital.

Statistical Analysis

Analysis was carried out with SPSS version 10. Results were considered statistically significant when $P < 0.05$. Univariate analysis was used to determine the risk factors that were significantly associated with EUPR or LUPR. A multinomial logistic regression was performed to determine the risk factors associated with early unplanned readmissions and late unplanned readmissions. The risk factors were removed in a step-wise manner to leave the factors that would be significantly associated with unplanned readmissions, both early and late.

To determine if our derived models could predict unplanned readmissions and early unplanned readmissions, we performed a logistic regression analysis and produced receiver operator characteristic (ROC) curves with the predicted probabilities for the following models: all risk factors, risk factors from the multinomial regression that had been transformed into categorical variables, and a clinical prediction rule, which was derived from the odds ratios of the logistic regression models (using factors

Table 1. Baseline Demographic and Clinical Characteristics and Functional Status

	Early unplanned readmission to the acute hospital (n = 63)	**Late unplanned readmission to the acute hospital (n = 86)**	**Planned discharge (n = 682)**	***P***
Age (mean ± standard deviation)	75.9 ± 9.3	77.4 ± 9.5	76.1 ± 9.3	0.425
Gender (% males)	42.9%	52.3%	43.0%	0.253
Type of patient [n (%)]				
Stroke	11 (17.5%)	9 (10.5%)	115 (16.9%)	0.126
Hip Fracture	7 (11.1%)	8 (9.3%)	82 (12.0%)	
Debility following a medical illness	32 (50.8%)	40 (46.5%)	244 (35.8%)	
Debility following a surgical illness	9 (14.3%)	25 (29.1%)	197 (28.9%)	
Others	4 (6.3%)	4 (4.7%)	44 (6.5%)	
Barthel Index				
Premorbid	92.4 ± 14.2	88.9 ± 20.2	92.4 ± 16.8	0.207
Admission to the CH	29.6 ± 26.7	36.8 ± 23.0	48.1 ± 21.8	< 0.001
MMSE (mean ± standard deviation)	8.4 ± 10.9	13.8 ± 11.2	16.3 ± 10.8	< 0.001
Triceps Skin Fold Thickness (mm, mean ± standard deviation)	14.2 ± 6.0	12.7 ± 4.9	14.6 ± 6.3	0.027

CH: community hospital; MMSE: Mini-mental State Examination

determined from the earlier multinomial regression). The MMSE score was included as a factor for EUPR, but not for UR as it was not a significant factor in the later logistic regression model. The sensitivity, specificity, likelihood ratios and post-test probabilities were calculated for various scores on the clinical prediction rule.

Results

There were 1238 patients eligible for inclusion in the study. Of these, 842 patients gave informed consent. 831 patients were eligible for analysis. The other 9 patients did not complete their rehabilitation stay for social reasons.

The rate of EUPR was 7.6% and the rate of LUPR was 10.3%. There was no statistical difference in terms of demographic factors. However, there was a difference in terms of the BI score on admission to the community hospital, the MMSE score and the TSFT (Table 1). Univariate analysis of the CIRS scores among the 3 groups showed that there was a significant difference in the scores in the following organ systems: heart, haematopoietic, respiratory, upper gastrointestinal tract, lower gastrointestinal tract, renal, genitourinary and endocrine/metabolic (Table 2).

Table 3 shows the factors that were associated with EUPR and LUPR. The BI, the CIRS-heart, CIRS-haemopoietic and CIRS-endocrine/metabolic were the 4 factors that were common for unplanned readmissions for both time frames.

Three ROC curves were produced to study the diagnostic accuracy of the following models: all risk factors, risk factors from the multinomial regression which had been transformed into categorical variables, and the clinical prediction rule (Table 4). The MMSE score was not included in the model for the prediction of UR, as this was not significant in the logistic regression analysis. The areas under the curve (AUC) of the model of the clinical prediction rule was 0.745 [95% confidence interval (95% CI), 0.678-0.812] and 0.733 (95% CI, 0.687-0.778) for EUPR and UR, respectively. The likelihood ratios and post-test probabilities for various ranges of scores on the prediction rules are shown in Table 5. The AUCs of the other 2 models are shown in table 6.

Discussion

Our study showed that the cardiac status, the haemopoietic status, the endocrine/metabolic status and the functional status were the most important factors in determining the rate of both categories of unplanned readmissions. For early unplanned readmissions, the MMSE was significant. For late unplanned readmissions, the liver status and the TSFT were significant. We were also able to derive clinical prediction rules that were able to predict the risk of unplanned readmissions with moderate accuracy.

Prior studies of readmissions have mainly been of older patients from acute hospitals. Nevertheless, most do show that the functional status and the comorbidity status of patients are factors that would predict readmissions. Most studies have focused on the number of organ impairments rather than the type of organ impairments. Studies of common chronic disease show that cardiac disease, in the form of heart failure,[15, 16] has consistently been associated with readmissions. Other types of organ impairment that have been implicated included chronic obstructive pulmonary disease and end-stage renal failure.[15] There have been conflicting results on the contribution of mental state to readmission rates. Di Iorio and colleagues found that early readmissions (less than 3 months) were associated with MMSE scores; however, Alarcon and colleagues found that scores on the short portable mental status questionnaire were not associated with readmissions over a 6 month period.[17,18] Our finding of cognition being related to readmissions at an earlier phase of the readmission may be a reason contributing to the variability of its importance.

The finding of cardiac and endocrine/metabolic diseases being risk factors for readmission suggests that apart from the traditional input from geriatricians, input from cardiologists and endocrinologists may be important as well. Otherwise, it may mean that a screening procedure should be put in place to exclude patients with significant cardiac or endocrinological morbidity from community hospital care.

If possible, patients who are at high risk of readmissions should be managed at acute hospitals or community hospitals at closer proximity to acute hospitals. Unfortunately, the multi-level likelihood ratios we have derived at best are either moderately positive or negative, and may not be able to predict an individual's risk of readmission with great certainty.[19] However, they will be able to give the community hospital practitioner an idea of the likelihood of acute hospital readmission for the community hospital as a whole, based on the mix of risk scores. For patients with higher scores, for example when the likelihood ratio is more than 3, the post-test probability for readmission would be 31.9% and 40.8% for EUPR and UR, respectively. Patients with risk scores in the higher range would probably be better managed in the acute hospital setting. Deciding cut-offs can also be based on the distance from the acute hospital. For example, a community hospital at a greater distance from an acute hospital or with a lower level of medical expertise, with presumably a lower tolerance for readmissions would only take patients with lower scores. The alternative strategy would be to provide community hospitals with differing levels of medical expertise.

Table 2. Cumulative Illness Rating Scores of the Sample Categorised as None to Mild impairment, Moderate Impairment, Severe Impairment

Organ system involvement	Early unplanned readmission to the acute hospital (n = 63)	Late unplanned readmission to the acute hospital (n = 86)	Planned discharge (n = 682)	*P*
Heart (%)				
N/M	39.7%	45.3%	67.0%	<0.001
Mod	49.2%	43.0%	27.9%	
Sev	11.1%	11.6%	5.1%	
Vascular (%)				
N/M	15.9%	25.6%	27.6%	0.191
Mod	84.1%	74.4%	71.3%	
Sev	0%	0%	1.2%	
Haemopoietic (%)				
N/M	49.2%	48.8%	62.3%	0.002
Mod	30.2%	31.4%	28.3%	
Sev	20.6%	19.8%	9.4%	
Respiratory (%)				
N/M	73.0%	65.1%	77.6%	0.023
Mod	4.8%	14.0%	9.7%	
Sev	22.2%	20.9%	12.8%	
EENT (%)				
N/M	87.3%	83.7%	85.2%	0.830
Mod	0%	2.3%	2.1%	
Sev	12.7%	14.0%	12.8%	
Upper GI (%)				
N/M	30.2%	36.0%	50.7%	0.003
Mod	31.7%	34.9%	26.2%	
Sev	38.1%	29.1%	23.0%	
Lower GI (%)				
N/M	44.4%	50.0%	35.2%	0.025
Mod	46.0%	39.5%	56.9%	
Sev	9.5%	10.5%	7.9%	
Renal (%)				
N/M	71.4%	73.3%	82.4%	0.006
Mod	0%	0%	0.9%	
Sev	28.6%	26.7%	15.0%	
Genitourinary (%)				
N/M	65.1%	55.8%	67.2%	
Mod	7.9%	10.5%	12.6%	0.045
Sev	27.0%	33.7%	20.2%	
Musculoskeletal (%)				
N/M	74.6%	76.7%	69.6%	0.645
Mod	1.6%	2.3%	2.8%	
Sev	23.8%	20.9%	27.6%	

Table 2. Continued

Organ system involvement	Early unplanned readmission to the acute hospital (n = 63)	Late unplanned readmission to the acute hospital (n = 86)	Planned discharge (n = 682)	*P*
Neurological (%)				
N/M	42.9%	50.0%	53.4%	0.385
Mod	4.8%	7.0%	7.0%	
Sev	52.4%	43.0%	39.6%	
Endocrine/Metabolic (%)				
N/M	44.4%	47.7%	63.5%	0.002
Mod	49.2%	48.8%	32.3%	
Sev	6.3%	3.5%	4.3%	
Psychiatric (%)				
N/M	81.0%	86.0%	84.2%	0.131
Mod	0%	5.8%	4.0%	
Sev	19.0%	8.1%	11.9%	

Percentages are column percentages
EENT: eye/ear/nose/throat; GI: gastrointestinal tract; Mod: moderate impairment; N/M: none to mild impairment; Sev: severe impairment

Community hospitals with a higher skill level would accommodate a larger number of patients with higher probabilities of readmission.

A weakness of our study is that it included only two-thirds of the eligible population. As we do not have any data on the population that did not give consent, we are unable to ascertain if there is a systematic difference between the included and excluded populations. Another weakness of the study was that we did not evaluate the effect of delirium on unplanned readmissions, as it was not designed to. Assessing delirium would have required longitudinal observation of the patient either in the acute hospital setting or in the community setting. Unfortunately assessing delirium is currently not widely practiced and a one-point evaluation by our research assistants could have been inaccurate. Future studies would do well to focus on this. The strength of our study is that it is a collaborative study of both acute and community hospitals, which allows us to obtain both acute hospital and community hospital data. In addition, this is one of the largest studies on readmissions of older people.

Our study is an observational study of 2 community hospitals in Singapore. There would be several factors affecting the generalisability of our findings to community hospitals in other countries, such as the level of equipping, the size of the community hospital, the level of expertise of the hospital, and the distance from a general hospital. The community hospitals in Singapore are generally large, are run by residential physicians with 1 of its members having further qualifications in family medicine, and with variable degrees of input from geriatricians. Both facilities have radiological facilities on site. Patients in this study were admitted mainly for rehabilitation. They are generally frail and would usually tolerate only 1 session of rehabilitation a day. The results would not be applicable to patients admitted for other reasons. Thus the identified factors may not necessarily be useful as a predictor of the readmission rate. However, they are likely to give an indication of the factors that are associated with unstable disability.[20]

Conclusion

Patients who have unplanned readmissions can be identified by their functional status, the MMSE, the TSFT and by the degree of organ impairment in the cardiac, haemopoietic, liver and endocrine/metabolic systems.

Acknowledgements

The study was supported by the National Medical Research Council Grant NMRC/0899/2004.

Table 3. Multinomial Regression of Factors Affecting Unplanned Readmissions (Early and Late) Versus Planned Readmissions

	Odds ratio (95% confidence interval)	*P*
Early unplanned readmissions		
Admission Barthel Index	0.97 (0.96-0.99)	<0.001
MMSE	0.96 (0.93-0.99)	0.012
CIRS – Heart		
N/M	1	
Mod	2.14 (1.17-3.91)	0.014
Sev	4.12 (1.56-10.94)	0.004
CIRS – Haemopoietic		
N/M	1	
Mod	1.46 (0.76-2.80)	0.257
Sev	3.73 (1.68-8.28)	0.001
CIRS – Endocrine/Metabolic		
N/M	1	
Mod	2.15 (1.19-3.89)	0.011
Sev	2.89 (0.84-9.95)	0.091
Late unplanned readmissions		
Admission Barthel Index	0.98 (0.97-0.99)	<0.001
Triceps Skin Fold Thickness	0.93 (0.89-0.98)	0.006
CIRS – Heart		
N/M	1	
Mod	1.81 (1.09-3.03)	0.023
Sev	3.50 (1.55-7.88)	0.003
CIRS – Haemopoietic		
N/M	1	
Mod	1.32 (0.77-2.26)	0.322
Sev	2.88 (1.46-5.65)	0.002
CIRS – Liver		
N/M	1	
Mod	0.41 (0.04-3.92)	0.322
Sev	2.87 (1.89-9.76)	<0.001
CIRS – Endocrine / Metabolic		
N/M	1	
Mod	2.00 (1.21-3.28)	0.006
Sev	1.36 (0.38-4.90)	0.635

CIRS: Cumulative Illness Rating Scale; MMSE: Mini-mental State Examination; Mod: moderate impairment; N/M: none to mild impairment; Sev: severe impairment

Table 4. Scoring System for Clinical Prediction Rule for the Prediction of All Unplanned Readmissions and for Early Unplanned Readmissions

	Scoring system for all unplanned early readmissions	Scoring system for unplanned readmissions
Barthel index		
0-20	4	2
21-40	2	1
41-60	1	1
61-80	1	1
81-100	1	1
Triceps skin fold		
Thickness		
8 mm and below	2	NA
8.1-13.0 mm	1	NA
13.1-17.0 mm	1	NA
more than 17.0 mm	1	NA
MMSE		
0	NA	4
1-17	NA	1
18-24	NA	1
25 and above	NA	1
CIRS – Heart		
N/M	1	1
Moderate	2	2
Severe	3	3
CIRS – Haematological		
N/M	1	1
Moderate	1	1
Severe	3	3
CIRS – Liver		
N/M	1	NA
Moderate	1	NA
Severe	3	NA
CIRS – Endocrine/Metabolic		
N/M	1	1
Moderate	2	2
Severe	2	3

CIRS: Cumulative Illness Rating Scale; MMSE: Mini-mental State Examination; NA: not applicable; N/M: none to mild impairment

Table 5. Multi-level Likelihood Ratios for All Unplanned Readmissions and for Early Unplanned Readmissions Based on the Clinical Prediction Rule

All unplanned readmissions			Early unplanned readmissions		
Score	**Likelihood ratio**	**Post-test probability**	**Score**	**Likelihood ratio**	**Post-test probability**
4-5	0.34	6.9%	3-6	0.42	3.3%
6-8	0.93	15.8%	7-10	2.16	15.1%
9 and above	3.16	40.8%	11 and above	5.69	31.9%

Pretest probability of all unplanned readmissions and early unplanned readmissions was 17.9% and 7.6% respectively.

Table 6. Characteristics of the Receiver Operator Curves of Models Predicting Early and All Unplanned Readmissions

	Area under the curve (95% confidence interval)	
	Prediction of all unplanned readmission	**Prediction of early unplanned readmission**
Full Model	0.829 (0.778-0.880)	0.797 (0.757-0.838)
Simplified Model – a	-	0.762 (0.718-0.806)
Simplified Model – b	0.774 (0.714-0.834)	-
Clinical prediction rule – a	-	0.733 (0.687-0.778)
Clinical prediction rule – b	0.745 (0.678-0.812)	-

The full model refers to the logistic regression model with all demographic, medical, physical function, cognitive function and nutrition variables. Simplified models are based on the logistic regression model of the risk factors identified in the multinomial regression model (Table 3). The Mini-mental State Examination was not included in the prediction of unplanned discharge as this was not found to be significant in the logistic regression model. Clinical prediction rules are based on the odds ratios of the simplified models.

REFERENCES

1. Steiner A. Intermediate care-a good thing? Age Ageing 2001;30(suppl 3):33-39.
2. Carpenter I, Gladman JR, Parker SG, Potter J. Clinical and research challenges of intermediate care. Age Ageing 2002;31:97-100.
3. Ministry of Health, Singapore. Intermediate and long-term care in Singapore. Singapore: Ministry of Health, 2006. Available at: http://www.moh.gov.sg/mohcorp/uploadedFiles/Publications/Information_Papers/2006/MOH_Info_Paper_on_ILTC__18_October_2006.pdf. Accessed 28 May 2007.
4. Heaney D, Black C, O'Donnell CA, Stark C, van Teijlingen E. Community hospitals-the place of local service provision in a modernising NHS: an integrative thematic literature review. BMC Public Health 2006;6:309.
5. Green J, Young J, Forster A, Mallinder K, Bogle S, Lowson K, Small N. Effects of locality based community hospital care on independence in older people needing rehabilitation: randomised controlled trial. BMJ 2005;331:317-22.
6. O'Reilly J, Lowson K, Young J, Forster A, Green J, Small N. A cost effectiveness analysis within a randomised controlled trial of post-acute care of older people in a community hospital. BMJ 2006;333:228.
7. Campbell SE, Seymour DG, Primrose WR. A systematic literature review of factors affecting outcome in older medical patients admitted to hospital. Age Ageing 2004;33:110-5.
8. Young J, Donaldson K. Community hospitals and older people. Age Ageing 2001;30(Suppl 3):7-10.
9. Tomlinson J, Raymond NT, Field D, Botha JL. Use of general practitioner beds in Leicestershire community hospitals. Br J Gen Prac 1995;45:399-403.
10. Yap LK, Ow KH, Hui JY, Pang WS. Premature discharge in a community hospital. Singapore Med J 2002;43:470-5.
11. Miller MD, Towers A. A manual of guidelines for scoring the cumulative illness rating scale for geriatrics (CIRS-G). Pittsburgh: University of Pittsburgh, 1991.
12. Shah S, Vanclay F, Cooper B. Improving the sensitivity of the Barthel Index for stroke rehabilitation. J Clin Epidemiol 1989;42:703-9.
13. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state." A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189-98.
14. Donini LM, De Bernardini L, De Felice MR, Savina C, Coletti C, Cannella C. Effects of nutritional status on clinical outcomes in a population of geriatric rehabilitation patients. Aging Clin Exp Res 2004;16:132-8.
15. Chu LW, Pei CK. Risk factors for early emergency hospital readmission in elderly medical patients. Gerontology 1999;45:220-6.
16. Philbin EF, Rocco TA Jr, Lindenmuth NW, Ulrich K, Jenkins PL. Clinical outcomes in heart failure: report from a community hospital-based registry. Am J Med 1999;107:549-55.
17. Di Iorio A, Longo A, Mitidieri Contanza A, Bandinelli S, Capasso S, Gigante M, et al. Characteristics of geriatric patients related to early and late readmissions to hospital. Aging (Milano) 1998;10:339-46.
18. Alarcon T, Barcena A, Gonzalez-Montalvo JI, Penalosa C, Salgado A. Factors predictive of outcome on admission to an acute geriatric ward. Age Ageing 1999;28:429-432.
19. Straus SE, Richardson WS, Glasziou P, Haynes RB. Evidence-based Medicine – How to Practice and Teach EBM. 3rd ed. Edinburgh: Churchill Livingstone, 2005.
20. Campbell AJ, Buchner DM. Unstable disability and the fluctuations of frailty. Age Ageing 1997;26:315-8.