

# Development of a casemix classification system for inpatient rehabilitation services: Stage 1 of the Victorian Rehabilitation Project

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## Abstract

*This study examines the feasibility of classifying rehabilitation patients according to relative cost and proposes an option for a casemix classification and payment system for rehabilitation services in Victoria. The classification system proposed has 16 mutually exclusive groups based on patient diagnosis, change in functional status, admission functional status and age, using patient length of stay as a proxy for cost. Data relating to five hospitals were collected over three months during 1994, resulting in 483 inpatient episodes from a variety of impairment groups. The data were analysed using an analysis of variance model (PC Group), with the resulting model accounting for 30 per cent of the variance in length of stay. The study also considers the implications of incentives to contain cost and concludes by suggesting that such a payment system would be feasible to implement following further research to validate and refine the system.*

## Introduction

The Victorian Rehabilitation Project is a two-stage project established to develop a casemix classification and funding mechanism for designated rehabilitation services in Victoria. While it is expected that a comprehensive patient-based system will be developed over several years, this project was established to provide the foundation for an initial classification and payment system. This paper outlines Stage 1 of the project, which commenced in April 1994. Stage 1 sought to determine the feasibility of collecting a data set of patient variables and

resource inputs which could be used to develop a casemix classification and payment system for inpatient rehabilitation services. Stage 2, which commenced in December 1994, extended the work of Stage 1 and sought to develop relative resource weights for the different types of rehabilitation patients identified.

Non-acute inpatient services, such as rehabilitation, do not fit well into the current Australian national diagnosis related group (AN-DRG) casemix model and are currently excluded from the Victorian casemix payment mechanism. As an interim payment model, a crude bed-day rate is used to fund designated inpatient rehabilitation programs in Victoria. However, a casemix classification system which can account for the variability in the cost of treating different types of rehabilitation patients is required in order to provide appropriate incentives for the efficient treatment of patients.

Rehabilitation is commonly required following accidents, injury or illnesses where there is a significant loss of function and where there is a reasonable expectation of improvement of function. The *National Health Data Dictionary* Version 4 (National Health Data Committee 1995) defines an episode of rehabilitation care as 'when a person with a disability is participating in a multi-disciplinary program aimed at improvement in functional capacity, retraining in lost skills and/or change in psychosocial adaptation'. In Victoria, rehabilitation services are currently provided primarily through acute hospitals and aged care centres.

A prospective payment system for rehabilitation services should be both clinically meaningful and cluster patients into resource-homogeneous groups. It should provide appropriate incentives to ensure quality care, be easily administered and minimise the opportunities for cost-shifting, the unnecessary splitting of the patient episode or reduction in continuity of care. The feasibility of collecting the data in order to classify patients, the various incentives and disincentives which may have an impact on patient outcomes, and the level to which resource utilisation can be explained by patient classifications should also be considered.

When seeking to predict resource utilisation in non-acute care, the patient's diagnosis and functional status (level of physical disability), as measured by an Activities of Daily Living (ADL) scale, have emerged as promising trends in the literature. (ADL scales seek to measure the type and amount of assistance required by a disabled person to perform basic functional activities such as eating, bathing, toileting and walking. A detailed literature review is contained in the unpublished thesis by the same title, which forms the basis for this paper.) To date, however, a number of the studies to develop casemix measures for non-acute inpatient services have focused on nursing home care, where the length of stay is indefinite once the patient enters care. As a result, several mechanisms for

considering non-acute care focus on daily measures of patient dependency rather than considering the entire episode of care. By applying bed-day rates to inpatient rehabilitation services, there are no incentives to contain patient length of stay, improve treatment efficiency or vary the intensity of treatment over shorter or longer lengths of stay.

## **Payment models**

Using a casemix system for payment purposes requires both a classification model and a payment model. Classification may be based on various measures including diagnosis, functional status, severity of illness, prognosis or outcome. This study considers diagnosis and functional status as the two main classification tools. Functional status is measured by the Modified Barthel Index (MBI), an ADL scale in common use in Victoria.

The payment system establishes a set of incentives and describes the process by which payment will be determined. Payment may be based on a daily rate, a treatment episode or on the patient's outcome (for instance, level of functional gain achieved). Wilkerson, Batavia and DeJong (1992) consider four episode payment models using functional status measures: functional status at admission, as a severity measure; functional status at discharge, as a severity/outcome measure; change in functional status from admission to discharge, as an outcome/progress measure; and functional status from admission to discharge to follow-up, as a progress/retention measure. These models are considered briefly under two broad headings.

### **Functional status at admission or discharge**

A number of studies (Stineman et al. 1994; Subramaniam, Gray & Walker 1994) consider functional status at admission to predict patient length of stay. Wilkerson, Batavia and DeJong (1992) describe this as a 'snapshot' measure of severity. Translated into a payment model, this is a truly prospective method of payment and would be administratively simple. However, such a model may enable service providers to accept only those patients who may regain function without the need for intensive rehabilitation. There is also no incentive to achieve an acceptable patient outcome, such as improvement in function. Similarly, using functional status at discharge, while not prospective, still enables patient selection based on the anticipated payment category at discharge. As no measure of functional status is considered at admission, patients with less severe conditions requiring rehabilitation may dominate.

## Change in functional status

Wilkerson, Batavia and DeJong (1992) also propose payment on change in functional status from admission to discharge or from admission to follow-up to encourage the enhancement of patient functional status. Service providers would need to focus on gain in function and would not be so able to select patients based on their status at a particular point in time, admission or discharge. However, this type of model has the disadvantage of providing inducements to cease rehabilitation when it is believed that no more gain may be achieved, perhaps at a temporary plateau. It is also affected by the measurement instrument used in determining functional status. Wilkerson and colleagues note that there may be a ceiling effect where the instrument is not capable of measuring further gains in functional status beyond a certain point. The MBI does not consider finer physical function nor cognitive impairment and so is likely to be subject to this disadvantage. However, patients who are capable of scoring highly on this index are perhaps better treated as outpatients.

Functional gain may be extended to the follow-up period when the patient has returned to the community. This type of model focuses on long-term gains for the patient. A disadvantage of this model is the low level of control the service provider is likely to have over the longer term outcomes for the patient and the extent to which the service provider should be held accountable for these factors.

Functional status at admission and change in functional status from admission to discharge were modelled on the data collected.

## Overview of the study

This study sought to build on previous studies by focusing on diagnostic measures and incorporating functional status to predict resource consumption. Rather than considering daily measures of ADL, the study focused on classifying the entire episode of patient care to maximise incentives to contain length of stay and improve efficiency.

While a variety of different ADL measures have been used in the various studies conducted to date, this study used the MBI as a measure of the type and amount of assistance required by a disabled person to perform basic functional activities such as eating, bathing, toileting and walking. It is a 100-point rating scale of a patient's ability to complete nine self-care and six mobility tasks which are each assigned a value according to four levels of assistance: independent, with aids, with assistance or dependent.

Five hospitals contributed data to the study: the Alfred Healthcare Group, the then Austin Hospital, Bundoora Extended Care Centre, Eastern Suburbs Geriatric Centre and the Queen Elizabeth Centre. Three behavioural measures from the National Nursing Home Resident Classification Instrument (RCI) were examined to consider the resource consumption of patients with behavioural disturbances. As the MBI does not contain any cognitive measures, the RCI measures, which focus on the number of staff interventions required due to physical aggression, verbal disruption or other behaviour, were included to attempt to capture this dimension.

Length of stay was used as proxy for cost in considering classification models, as the longer a patient is in hospital, the more medical, nursing, hotel and other costs will be incurred. Hospital charges and length of stay have also been found to be highly correlated (Stineman et al. 1994). Length of stay, however, does not account for patient dependency or the intensity of rehabilitation care received. It would be anticipated that a patient with spinal cord injury would require a higher level of nursing care each day than a patient who is being rehabilitated following a hip replacement. Variability in nursing intensity and allied health care was not taken into account.

Data on patients' clinical sub-program, primary diagnosis (using ICD-9-CM), age, sex, admission and discharge functional status and behavioural disturbance as measured by the three items from the RCI and a patient's length of stay in rehabilitation were collected.

## **Subjects**

Both geriatric and younger rehabilitation patients were included in the study. The study followed all patients admitted to rehabilitation during a two-month period, with a tailing-off period as patients were discharged. The Austin and the Queen Elizabeth Centre provided data retrospectively. At the Queen Elizabeth Centre this included all patients admitted to rehabilitation from 11 January 1994 to 23 June 1994, with a tailing-off period as patients were discharged. At the Austin, all patients discharged during July 1994 and August 1994 for which complete data were available were included in order to coincide with the time frame for prospective data collection at the other hospitals and to capture particular rehabilitation patients with a longer length of stay, such as spinal cord injury.

Data were collected on 483 patients (213 males and 270 females), with an average age of 69.9 years and a variety of conditions requiring rehabilitation. Patients with an abnormally short (less than four days) or long length of stay (more than three standard deviations above the mean for their impairment

group) were trimmed out to prevent any undue influence on the classification model. This resulted in a trimmed data set of 463 patients (205 males and 258 females) with a mean age of 69.3 years.

### **Statistical analysis**

The classification analysis was undertaken using a computer program called PC Group (Austin Data Management Associates 1992) to determine optimum patient groupings which reduced within-group variance and maximised between-group variance based on the dependent variable. PC Group uses classification analysis to build models using classification trees and to partition patients into mutually exclusive groups based on the dependent variable. Trial solutions are found and tested in terms of variance reduction determined through an analysis of variance model.

Analysis commenced by testing the effect of various diagnostic groups formed through the use of the clinical sub-program and impairment codes from the Uniform Data Set for Medical Rehabilitation. These sub-groups were then tested again using diagnosis, admission MBI score, change in MBI score, age and onset interval. A second split was made where the variance reduction added to the tree, was significant at the .05 probability level and met a minimum group size of 20 patients. The process of splitting continued until no further splits were justified. Numerous different trees were constructed using different combinations of variables with length of stay as the dependent variable. One of the resulting classification trees is considered subsequently.

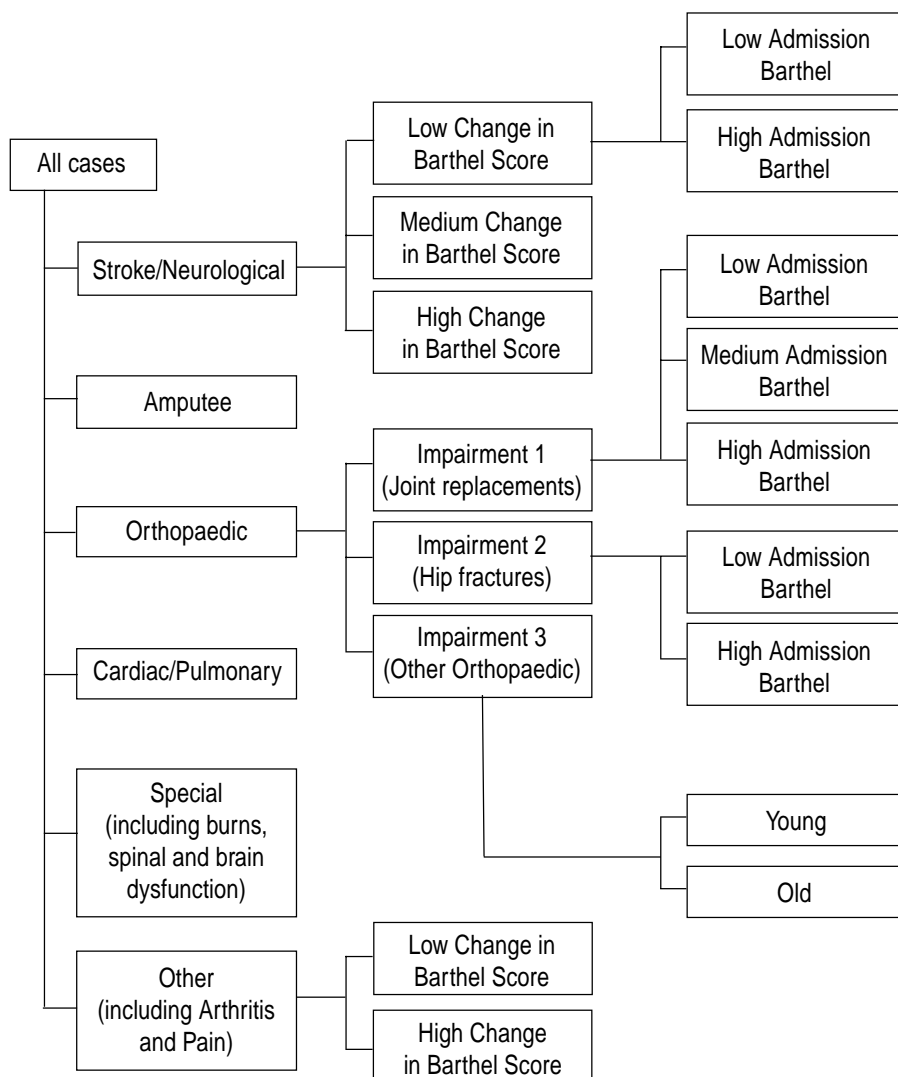
### **Results**

With length of stay as the dependent variable, patients were grouped initially into six impairment groups: Stroke/Neurological, Amputee, Orthopaedic, Cardiac/Pulmonary, Special (spinal cord, brain dysfunction and burns) and Other (Arthritis, Pain and Other Conditions). The Special group was made up of those cases that had a high degree of variability in treatment prognosis and low numbers. It was considered that these two factors would not lend themselves well to casemix systems and, therefore, that this group would most appropriately be funded on a bed-day basis.

Orthopaedic was the largest group with 201 cases, followed by Stroke/Neurological with 100 cases, Other with 60 cases, Cardiac/Pulmonary with 40 cases, Amputee with 33 cases and Special with 29 cases. These groups were then split using the next optimal predictor variable. This tree accounted for

30.24 per cent of the variance in length of stay ( $F(15\ 445) = 12.858$ ,  $p < .001$ ) and resulted in a classification tree with 16 groups referred to as Functional Impairment groups (see figure 1).

**Figure 1: Functional Impairment Groups**



The Orthopaedic sub-tree accounted for 35.78 per cent of the variance in length of stay for this group of patients, the Stroke/Neurological sub-tree accounted for 28.42 per cent of the variance and the Other group accounted for 18.03 per cent. The Cardiac/Pulmonary impairment group had insufficient cases to split

(40 patients), as did the Special group (29 patients) and the Amputee group (33 patients).

While the Cardiac/Pulmonary group and the Special group had insufficient cases to warrant a further split, relaxing the minimum group size indicated onset interval may possibly act as a splitting variable for Cardiac/Pulmonary. The Special group could possibly be split further using change in MBI score; the Amputee group also appeared likely to split further using a change in MBI score. Should a larger sample size be obtained, these predictor variables could be tested further.

## Discussion

In considering a classification system for rehabilitation patients, it appears that diagnosis (using impairment groups), admission MBI score, change in MBI score, onset interval (from admission to the acute episode to commencement of rehabilitation) and age are all significant predictors of length of stay. The relationship between admission MBI and patient length of stay is not surprising. The MBI is a measure of the patient's functional dependency and examines their ability to perform basic activities of daily living and the requirement for assistance or supervision in performing these tasks. Therefore, it is anticipated that a person admitted with lower function may require longer to return to a level of function necessary to return to the community than someone admitted with a higher level of function.

As improvement in function is the aim of rehabilitation, change in MBI score is also a logical predictor of length of stay on the basis that greater improvements in function would be expected the longer the person is treated. Once the patient no longer requires assistance with the basic activities measured by the MBI, rehabilitation may conclude or continue on an outpatient basis.

While change in MBI score was often the most significant predictor of length of stay for a number of impairment groups, it could be argued that this is not a prospective measure as the degree of change is not known at the time of the patient's admission. However, decisions regarding who should receive rehabilitation rest on an assessment of the patient's prognosis for recovery. Payment on the basis of functional improvement should be considered, due to the discretionary nature of the provision of rehabilitation services and the aim of rehabilitation.

In the present study, age was not used extensively as a splitting variable in any of the solutions, however, it was noted as a lesser option on many occasions. It



is likely that a bigger sample size which could enable the classification to be developed more fully may result in age being used more as a splitting variable.

While the three RCI measures did not prove useful predictors of length of stay, behavioural factors, cognitive ability and co-morbidities warrant further consideration for certain impairment groups. The current classification system provides only a framework and these factors would need to be captured and included in subsequent refinements.

## **Payment policies**

To implement a funded casemix classification system for rehabilitation patients, consideration must be given to the incentives built into any proposed model. While incentives that reduce quality of care, promote premature discharge or reduce access to rehabilitation services should be avoided, those promoting efficiency and ensuring the equitable allocation of funding should be encouraged.

The payment system needs to ensure appropriate people get access to rehabilitation. As there is a discretionary component to the decision to accept someone into a rehabilitation program, the payment system needs to ensure that a balance is maintained between people who will benefit greatly from rehabilitation and those who may only make small but significant improvements in function. Patients who have a less positive prognosis should not be excluded by the system and facilities should not be able to 'cream' by only taking those patients who would get well without intensive intervention. Given the degree of flexibility and variability in demand and admissions, the number of designated rehabilitation beds should continue to be subject to formal approval.

The precise funding system may take a number of forms. A preferred model would be one that includes a fixed component as well as a variable payment. The fixed component would accommodate variations in patient mix and guard against premature discharge to some extent. A fixed grant could be provided to each hospital based on the hospital's current rehabilitation bed-day target. This fixed component could make up 60 per cent or more of the payment to the hospital. It would also require that the hospital meets a bed-day target. This payment could be viewed as covering hotel and basic nursing costs for the duration of the patient's stay. The hospital would also receive a case payment to cover rehabilitation for every patient treated according to the patient's classification. A possible exception would be patients in the Special group where, because of the small numbers and highly variable costs, a bed-day rate would still apply.

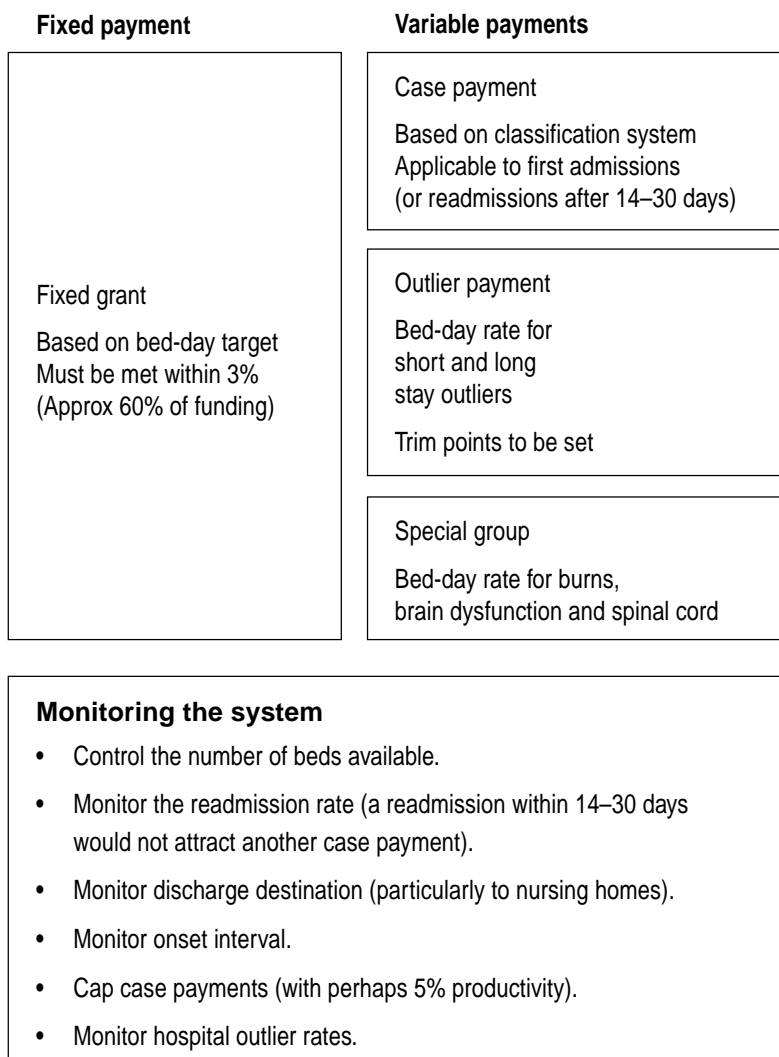
## **Length of stay**

Because of the relatively low volumes and the likelihood of very long lengths of stay within categories, the treatment of outliers requires special attention. One option for patients with an abnormally long length of stay is that an outlier payment could be made for every day the patient received treatment over a high boundary point. In the Victorian acute casemix system (Health and Community Services 1994, p 41) the high boundary point is set as three times the mean length of stay for the group. This could also be adopted for the rehabilitation groups, with an additional rate introduced once the patient passes the high boundary point.

Another option is to define the boundary point on clinical or empirical grounds, especially as the mean is highly skewed. The issue of short stay outliers to rehabilitation is also problematic in a payment sense as it is likely that these patients were considered inappropriate for rehabilitation. In the current study, patients with a length of stay of less than four days were not considered to have received an intensive rehabilitation program and were excluded from the sample. As these patients would not be eligible for a case payment, a bed-day rate could be applied, with possible discounts.

## **Readmissions**

It is also not uncommon for rehabilitation patients to be readmitted to rehabilitation due to an interruption to their program resulting from an acute illness or to be readmitted post-discharge due to further deterioration in their condition. Separate payments for each readmission may encourage interruptions to treatment. Therefore, for payment purposes, a period of time should be set (perhaps between 14 and 30 days) where, if the patient returns to rehabilitation, it is considered a continuation of the previous episode and no case payment is made. Bed-days could still accrue towards the hospital's bed-day target. The patient would also be eligible for outlier payments. Such a system may also act to discourage premature discharge as the hospital would still be liable to treat the patient if the patient returned due to premature discharge.

**Figure 2: Possible Rehabilitation Model**

## Conclusion

The Functional Impairment Groups proposed in this study are based on a limited set of data and so further work will be required to validate the model and test it more broadly on a larger sample size. This is being undertaken in Stage 2 of the project. It is also necessary to consider how many rehabilitation groups should be reasonably expected to cover the approximately 11 000 separations currently treated in designated rehabilitation programs in Victoria. While Functional Impairment Group classification currently leads to 16 groups, it is

possible that a larger data set could lead to further splits and greater explanation of variance. This needs to be carefully considered in terms of the number of groups that can be reasonably used. In the Victorian context, it would be expected that around 20 groups would be optimum.

This study demonstrates the feasibility of using relatively simple measures to classify rehabilitation patients into resource-homogeneous groups. It illustrates the usefulness of functional status (as measured by the MBI), change in functional status, diagnosis (as grouped into impairment categories) and age in predicting patient length of stay.

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