Research letters


A comparison of two assessment systems in predicting functional outcomes of older rehabilitation patients

SIR—Inpatient rehabilitation can improve physical functioning and quality of life of older persons with musculoskeletal (MSK) disorders [1–5]. For these persons, small gains in activities of daily living (ADLs) may result in large improvements in functional status and independence [4].

The advantage of rehabilitative services is clear; however, the availability of services is limited [6]. Consequently, it is useful to identify factors that may predict successful rehabilitation and target limited resources to patients most likely to benefit—this information would also help to provide realistic expectations to patients and caregivers, and to guide care and discharge planning [7, 8].

Assessment of rehabilitation potential and the potential success of rehabilitation for older patients is challenging due to medical complexity, frailty and multiple co-morbidities [9, 10]. Valid and reliable assessment systems that capture these characteristics could improve predictions of rehabilitation potential based solely on indicators of functional status. The Functional Independence Measure [FIM; 11] and interRAI/MDS (Minimum Data Set) assessments [12] are instruments designed to measure functional ability, are widely used with older persons and are mandated in multiple care settings. The interRAI/MDS instrument recommended for use in rehabilitation settings is the RAI-Post Acute Care [PAC; 13]. Compared to the FIM, the PAC contains additional information on common characteristics that reflect clinical complexity and, thus, may be predictive of outcome. A direct ‘head-to-head’ comparison of these instruments in the same population would provide important evidence for evaluating the utility of the FIM and MDS in older adults receiving rehabilitation [14].

The objective of this study was to collect data with both the FIM and PAC to assess their relative ability to predict discharge outcomes for older patients receiving inpatient rehabilitation.

Methods

Participants were from musculoskeletal (MSK) and geriatric rehabilitation units (GRU) at London Parkwood Hospital and Toronto Rehabilitation Institute (TRI). Parkwood has a 20-bed MSK and 30-bed GRU that both target frail older persons with multiple co-morbidities. Annually, the TRI GRU admits ∼200 patients and the MSK ∼850.

The FIM focuses on burden of care and measures both physical and cognitive disability [11]. It contains 18 items that are scored on seven-point ordinal scales based on the amount of assistance required [11, 15]. Thirteen items compose the motor subscale (FIM motor) and the remaining five items, the cognitive subscale [FIM cognitive; 16].

interRAI, an international research consortium, develops comprehensive assessment tools especially intended for older patients. Currently, there are 10 Resident Assessment Instruments (RAIs) designed for care settings across the continuum [16]. Each RAI tool consists of >300 items including specialised items exclusive to the specific setting as well as a proportion of common items intended to facilitate communication across the continuum [12, 16, 17].

There is evidence for the reliability and validity of both the FIM and the MDS. While there are extensive reports on the use of the FIM for older adults receiving inpatient rehabilitation, few MDS articles specifically focus on this population [14].

As the FIM is part of the National Rehabilitation Reporting System [NRS; 18] currently mandated for use in Ontario rehabilitation units, the FIM motor was collected in its usual manner for each institution. Prior to the PAC data collection...
period, staff assessors participated in orientation and standard training. The FIM and interRAI PAC data were measured and recorded for all consecutively consenting patients on admission and discharge.

### Statistical analysis

Using SAS 9.1 software [19], multiple linear regression models were constructed for the prediction of individual functional status at discharge, gain in functional status and rehabilitation efficiency [change in functional status/length of stay (LOS)]. Separate models were constructed for each instrument, and each model was stratified by rehabilitation unit type [MSK and GRU; 9]. For the PAC, models initially only contained items correspondingly available in the FIM; following this, comparison PAC models were created using the additional items available within the PAC system (see Table 1 for a list of PAC variables considered in these analyses). Univariate analyses, stepwise regression analyses and knowledge from previous studies were used to develop final PAC models that were efficient and clinically relevant.

This study received ethics clearance from the Research Ethics Boards at the University of Waterloo, the University of Western Ontario, the University of Toronto and the Toronto Rehabilitation Institute.

### Table 1. List of FIM and PAC variables and their corresponding beta value (P-value) in the final models for each of the three dependent variables stratified by unit type

<table>
<thead>
<tr>
<th></th>
<th>Change Efficiency Outcome</th>
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<tbody>
<tr>
<td></td>
<td>GRU</td>
</tr>
<tr>
<td><strong>FIM variables</strong></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>−0.25087</td>
</tr>
<tr>
<td>Gender</td>
<td>3.97426</td>
</tr>
<tr>
<td>FIM motor score</td>
<td>−0.38526</td>
</tr>
<tr>
<td>FIM cognitive score</td>
<td>0.61474</td>
</tr>
<tr>
<td><strong>PAC variables</strong></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.04919</td>
</tr>
<tr>
<td>Gender</td>
<td>1.26156</td>
</tr>
<tr>
<td>CHESS [30]</td>
<td>*</td>
</tr>
<tr>
<td>DRS [31]</td>
<td>*</td>
</tr>
<tr>
<td>CPS [32]</td>
<td>*</td>
</tr>
<tr>
<td>Pain [33]</td>
<td>*</td>
</tr>
<tr>
<td>Co-morbid index</td>
<td>*</td>
</tr>
<tr>
<td>Weight loss</td>
<td>*</td>
</tr>
<tr>
<td>Dehydration</td>
<td>*</td>
</tr>
<tr>
<td>Time from event to admission into unit</td>
<td>*</td>
</tr>
<tr>
<td>ADLs @ Time 1</td>
<td>−0.66842</td>
</tr>
<tr>
<td>Pre-morbid ADL status</td>
<td>0.0684</td>
</tr>
<tr>
<td>Pre-morbid IADL status</td>
<td>2.34940</td>
</tr>
<tr>
<td>Fatigue</td>
<td>*</td>
</tr>
<tr>
<td>Self-reported ill health</td>
<td>*</td>
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<tr>
<td>Health stability</td>
<td>*</td>
</tr>
<tr>
<td>Physical function improvement</td>
<td>*</td>
</tr>
<tr>
<td>Physical function improvement potential—individual</td>
<td>*</td>
</tr>
<tr>
<td>Physical function improvement potential—care professional</td>
<td>*</td>
</tr>
<tr>
<td>Easily distracted (c3a)</td>
<td>9.20159</td>
</tr>
<tr>
<td>Disorganised speech (c3b)</td>
<td>*</td>
</tr>
</tbody>
</table>

*Indicates not utilised in final linear regression model.
Figure 1. Proportion of explained variance by information system and rehabilitation unit type. FIM, Functional Independence Measure; PAC, interRAI Post Acute Care; GRU, geriatric rehabilitation unit; MSK, musculoskeletal rehabilitation unit.
Results

Participant characteristics are summarised in Appendix 1 (available in Age and Ageing online). For both the GRU \((n = 93)\) and MSK \((n = 115)\) groups, the PAC scores were slightly lower at the London site than the Toronto site, particularly on admission. Overall, however, few differences were found between groups; we therefore concluded that it was appropriate to combine the data from the two sites.

As expected, we found the GRU patients were older, had less variability in age [age: GRU = 81.4 (6.7), MSK = 76.4 (10.2)], were more physically impaired on admission and achieved similar functional gains to the MSK group over a longer period of time [LOS: GRU = 54.0 (33.4), MSK = 23.0 (16.2)]. The GRU group also had more co-morbid conditions than the MSK group when assessed using the Functional Comorbidity Index [20]. For the majority of MSK patients, the most responsible causes for their admission were MSK conditions (52%) and injury or trauma (40%). Conversely, in the GRU only half of the participants (51%) were admitted due to MSK conditions or injury. One-third of these patients (18%) had conditions related to their circulatory system, while the remaining GRU patients had a diverse range of other medical conditions. This population generally appears to be representative of GRU and MSK patients [9, 21–25].

Results of multiple regression models can be found in Table 1 and Figure 1. For each of the 18 models developed, functional status at Time 1 was a significant predictor of the three outcomes of interest: change scores, efficiency scores and functional status at discharge.

For the change scores, the FIM and PAC models containing age, gender and ADL score at Time 1 produced drastically different \(R^2\) values for the different unit types (FIM: GRU \(R^2 = 0.11\), MSK \(R^2 = 0.65\); PAC: GRU \(R^2 = 0.22\), MSK \(R^2 = 0.68\)). Rehabilitation efficiency scores resulted in low explained variance for both FIM models (GRU \(R^2 = 0.01\), MSK \(R^2 = 0.06\)) and constrained PAC models (ADL, age and gender only, GRU \(R^2 = 0.06\), MSK \(R^2 = 0.14\)).

For GRU patients, ability to predict functional status at discharge (PAC \(R^2 = 0.41\), FIM \(R^2 = 0.21\)), gain in functional status (PAC \(R^2 = 0.49\), FIM \(R^2 = 0.11\)) and rehabilitation efficiency (PAC \(R^2 = 0.41\), FIM \(R^2 = 0.21\)) were enhanced by adding three of the 26 additional PAC items investigated: pre-morbid ADL status, pre-morbid IADL status and delirium. In the MSK group, five additional PAC items enhanced variance explained for the efficiency scores in MSK units: time from event to admission, pre-morbid ADL status, delirium, disorganised speech and depression. The impact of additional PAC items in the model was less pronounced for the remaining discharge outcomes in the MSK group.

The linear regression models followed a similar pattern, with the additional PAC items increasing the percentage of explained variance.

Discussion

Overall, the PAC was more proficient than the FIM in explaining the variance in rehabilitation outcomes for the GRU and MSK. The PAC explained more variance than the FIM when only ADL items were entered into the model as well as when additional PAC items were included. The impact of including additional descriptive elements for predicting discharge outcomes was greater in GRU than MSK patients. This result was expected as GRU patients tend to be older and have more co-morbid conditions, which may influence their functional outcomes. However, in most cases, the additional PAC items still did not increase the explained variance to the level achieved for MSK patients.

Consistent with other reports, we found that functional status on admission was the strongest predictor of rehabilitation outcomes [8, 26]. Cognitive status [7, 27], number and type of co-morbid conditions [27, 28], age [8, 26, 28] and gender [28, 29] are other commonly reported predictors.

Few study participants had functional decline, which limited our ability to investigate predictors of negative outcomes. As this is true of most rehabilitation patients, we feel that this does not limit the generalizability of our results. The assessors were unblinded and may have been biased to rate rehabilitation patients more positively at outcome—the potential extent of bias is unclear without an untreated control group. However, as this was a comparative study, both instruments were likely to be equally affected. This dataset also only included persons receiving inpatient rehabilitation—different predictors may have been significant in other settings. We also aimed to mimic normal clinical practice to enhance the generalisability of our findings in this setting. Lastly, on the PAC, participants were rated as slightly more functionally able at the London site than at the Toronto site. This may be due to differing data collection methods, leading to more conservative change scores at the London site. We suspect that this is an artefact of the scale structure of the PAC relative to the FIM (10-item vs 13-item); with scores expressed as a percentage of the total score, the difference was minimal.

Overall, few PAC indicators significantly predicted rehabilitation outcomes when functional status on admission was known. This suggests that a strategy for predicting outcomes would be to add additional items to an existing functional ability scale, as the NRS adds to the FIM in Canada. However, advantages of the wider range of items in the PAC should also be considered—these include benefits for more comprehensive assessment, care planning and outcome measurement, and the potential for developing consistent quality indicators and outcome measures across a continuum. These advantages need to be balanced against the resource requirements related to the additional data collection.
Key points

- Capturing data related to the medical complexity of geriatric rehabilitation patients could enhance predictions of rehabilitation potential.
- Models for both the FIM and the PAC that contained functional status at Time 1 with no additional explanatory variables explained more variance in the musculoskeletal rehabilitation unit (MSK) than in the geriatric rehabilitation unit (GRU) patients.
- For GRU patients, pre-morbid ADL status, pre-morbid IADL status and a variable associated with delirium (‘easily distracted’) were significant predictors of all three rehabilitation outcomes considered.
- Additional information found in the PAC provides some improvement in the ability to predict outcomes, especially in GRU patients.

Acknowledgements

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Conflicts of interest

None declared.

Supplementary data

Supplementary data are available at Age and Ageing online.

Joshua Armstrong1, Christine Glenny1, Paul Stolee1,*, Katherine Berg2
1Department of Health Studies and Gerontology, University of Waterloo, Waterloo, ON, N2L 3G1 Canada
Tel: (+1) 519 888 4567 ext. 35879; Fax: (+1) 519 888 4362.
Email: stolee@uwaterloo.com
2Department of Physical Therapy, University of Toronto, Toronto, ON, M5G 1V7 Canada
*To whom correspondence should be addressed

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