The Timed Up and Go Test does not predict length of stay on an acute geriatric ward

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This study aimed to determine whether the admission Timed Up and Go Test (TUG) predicted the length of stay of patients in an acute geriatric ward. Consecutive patients were quasi-randomly allocated to either a model development sample or a model validation sample. Multivariate Cox proportional hazards regression was used to model length of stay. Variables considered for inclusion in the development model were risk factors for length of stay reported in the literature and univariate predictors from our dataset (p < 0.05). Variables selected for use in the development sample were then tested in the validation sample. Of 2463 patients of mean age 82.1 years, 932 (37.8%) were able to complete the TUG. Despite a significant, though weak, relationship between the length of stay and the TUG time (Spearman coefficient 0.18, p < 0.001), no time clearly identified patients with longer length of stay. Patients unable to complete the TUG had a median length of stay of 11 days (IQR 7 to 18), 40% longer than those able to complete the TUG (median 8 days, IQR 8 to 12, p < 0.001). Other significant (p < 0.05) predictors of length of stay in both samples were number of active medical diagnoses, referral from the emergency department, in-patient fall, and diagnosis of ulcer or infection. The admission TUG time should not be used to screen for patients likely to have longer lengths of stay. The value of the TUG lies in determining the patient's ability to complete it, rather than the time taken. [Gan N, Large J, Basic D and Jennings N (2006): The Timed Up and Go Test does not predict length of stay on an acute geriatric ward. *Australian Journal of Physiotherapy* 52: 141–144]

Key words: Frail Elderly, Length of Stay, Gait, Predictive Value of Tests

Introduction

By 2050, the number of older people worldwide is expected to increase from approximately 600 million to almost 2 billion (Anan 2002). The prevalence of chronic diseases and disability will increase substantially, and older people will occupy an increasing share of hospital beds. Casemix-based funding by Diagnosis-Related Groups disadvantages older persons (Chuang et al 2003), but is nevertheless used to predict the length of stay and costs of acute hospital care. Although physical function is believed to be an important predictor of outcomes in older people, it has seldom been used to adjust for casemix in evaluating resource use (Covinsky et al 1997).

Impaired function is a strong predictor of length of stay (Campbell et al 2004). The Timed Up and Go Test (TUG) is a widely-used and simple measure of basic mobility that compares well with other measures of balance and function (Podsiadlo and Richardson 1991). It involves a person standing from a chair, walking three metres, turning, walking back to the chair and sitting down. In a retrospective audit of 160 medical records, the TUG failed to predict falls on an acute medical ward (Lindsay et al 2004). To the best of our knowledge, no other publication has evaluated the TUG in an acute care setting.

The main aim of this study was to determine whether the TUG, measured on admission, predicted the length of stay of patients on an acute care unit for older people. If found to be useful, the TUG may be used to screen for patients likely to have longer admissions, in whom more comprehensive multidisciplinary interventions may improve outcomes and reduce overall costs of care. A useful TUG could also be evaluated for effectiveness in casemix-adjusted funding models. A secondary aim was to test the hypothesis that those unable to complete the TUG were more likely to have longer lengths of stay.

Method

**Subjects** The study was undertaken in the Aged Care Unit (Aged Care Unit) at Liverpool Hospital, a busy, tertiary referral hospital in south-western Sydney. The Aged Care Unit is a 20-bed multidisciplinary acute care unit for frail older people. Participants were consecutive patients admitted under the care of any of four geriatricians. Most were admitted based on geriatric targeting criteria that included functional impairment, gait abnormality and falls, deconditioning, multiple medical problems, delirium, polypharmacy, psychosocial problems, malnutrition, and multiple unplanned admissions (Wieland and Rubenstein 1996). The institutional review committee of the South Western Sydney Area Health Service approved the study protocol.

**Measurements** All patients were comprehensively assessed by a multidisciplinary team. The TUG was administered by a physiotherapist to all patients able to mobilise independently or with standby supervision (using a mobility aid when needed) within 24 hours of admission to the Aged Care Unit, or on the next working day after a weekend. Those with cognitive impairment were included if they were able to follow simple verbal commands, and interpreters were used for patients unable to speak English.

A geriatrician evaluated each patient for active medical
Table 1. Cox proportional hazards models for length of stay among those able to complete the TUG.

<table>
<thead>
<tr>
<th>Variable</th>
<th>PE</th>
<th>SE</th>
<th>p value</th>
<th>HR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Development model</strong>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log TUG time</td>
<td>-0.21</td>
<td>0.08</td>
<td>0.01</td>
<td>0.81 (0.69 to 0.95)</td>
</tr>
<tr>
<td>Number active diagnoses (co-morbidity)</td>
<td>-0.07</td>
<td>0.02</td>
<td>&lt; 0.001</td>
<td>0.93 (0.90 to 0.97)</td>
</tr>
<tr>
<td>Referral from ED</td>
<td>0.28</td>
<td>0.10</td>
<td>0.005</td>
<td>1.33 (1.09 to 1.62)</td>
</tr>
<tr>
<td>Fall during stay</td>
<td>-0.75</td>
<td>0.21</td>
<td>&lt; 0.001</td>
<td>0.47 (0.31 to 0.72)</td>
</tr>
<tr>
<td>Diagnosis of depression</td>
<td>-0.47</td>
<td>0.16</td>
<td>0.003</td>
<td>0.62 (0.45 to 0.85)</td>
</tr>
<tr>
<td>Diagnosis of any ulcer</td>
<td>-0.68</td>
<td>0.15</td>
<td>&lt; 0.001</td>
<td>0.51 (0.38 to 0.68)</td>
</tr>
<tr>
<td>Diagnosis of any infection</td>
<td>-0.44</td>
<td>0.10</td>
<td>&lt; 0.001</td>
<td>0.64 (0.53 to 0.79)</td>
</tr>
<tr>
<td><strong>Validation model†</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log TUG time</td>
<td>-0.17</td>
<td>0.08</td>
<td>0.04</td>
<td>0.85 (0.72 to 0.99)</td>
</tr>
<tr>
<td>Number active diagnoses (co-morbidity)</td>
<td>-0.08</td>
<td>0.02</td>
<td>&lt; 0.001</td>
<td>0.92 (0.89 to 0.96)</td>
</tr>
<tr>
<td>Referral from ED</td>
<td>0.42</td>
<td>0.10</td>
<td>&lt; 0.001</td>
<td>1.52 (1.24 to 1.85)</td>
</tr>
<tr>
<td>Fall during stay</td>
<td>-0.93</td>
<td>0.19</td>
<td>&lt; 0.001</td>
<td>0.39 (0.27 to 0.58)</td>
</tr>
<tr>
<td>Diagnosis of depression</td>
<td>-0.14</td>
<td>0.15</td>
<td>0.37</td>
<td>0.87 (0.65 to 1.17)</td>
</tr>
<tr>
<td>Diagnosis of any ulcer</td>
<td>-0.40</td>
<td>0.17</td>
<td>0.02</td>
<td>0.67 (0.48 to 0.93)</td>
</tr>
<tr>
<td>Diagnosis of any infection</td>
<td>-0.33</td>
<td>0.10</td>
<td>0.001</td>
<td>0.72 (0.59 to 0.88)</td>
</tr>
</tbody>
</table>

PE = parameter estimate, SE = standard error, HR = hazard ratio. *N = 461; 5 patients (1.08%) were censored due to death in hospital. †N = 470; 8 patients (1.70%) were censored due to death in hospital. ED = emergency department.

diagnoses (those causing physical, social or psychological dysfunction, or needing further investigations or changes to medications). Up to 10 active diagnoses were coded per patient.

Variables collected on admission to the Aged Care Unit were: source of referral, whether known to the community-based Aged Care Assessment Team, use of a mobility aid, serum albumin, presence of a pressure area, and demographic information. Variables collected during the stay in the Aged Care Unit were: active medical diagnoses, urinary (on three or more occasions) or faecal incontinence, in-patient falls, discharge domicile, referral for additional community services and length of stay (the number of days a patient stayed in the Aged Care Unit, calculated as the discharge date minus the admission date, plus one extra day).

Data analysis A logarithmic transformation was applied to the TUG times (designated ‘log TUG time’) to change the heavily right-skewed distribution into a near normal distribution. Multivariate Cox proportional hazards regression was used to model length of stay. Based on the last digit of the hospital medical record number, patients were quasi-randomly allocated to either a model development sample or a model validation sample. Variables considered for inclusion in the development model were risk factors of length of stay in the literature (serum albumin, overall co-morbid disease, acute stroke, dementia and delirium) (Campbell et al 2004) and univariate predictors of length of stay from our dataset (p < 0.05). These were removed one by one, using a backward selection method, until only significant variables remained. Variables selected for use in the development sample were then tested in the validation sample. Patients unable to complete the TUG were compared with those able to complete the TUG. Differences between groups were tested using t-tests for continuous, normally distributed variables, Fisher’s exact tests for dichotomous variables, and Kruskal-Wallis tests for ordinal variables.

The Spearman correlation coefficient was used to determine the association between continuous variables.

Results

Characteristics of study participants Between November 2000 and April 2005, 2463 patients of mean age 82.1 (SD 7.9) years were admitted to the Aged Care Unit. Of these, 932 (37.8%) were able to complete the TUG on admission (462 and 470 in the model development and validation samples, respectively). The common sources of referral were the emergency department (61%), other services at Liverpool Hospital following geriatric consultation (23%), and directly from the local community (10%). Sixty-one percent were women, 44% were born in a non-English speaking background (NESB) country and 54% were known to the Aged Care Assessment Team. Nine percent were living in a nursing home and 12% in a hostel. Sixty-five percent used a mobility aid before admission. During their stay in the Aged Care Unit, 8% of patients fell. The median number of active diagnoses per patient was 8 (IQR 6 to 10). The most common diagnoses were adverse drug reaction (41%), delirium (37%), dementia (37%), chronic cerebrovascular disease (30%), respiratory infection (27%), cardiac failure (26%), cardiac ischaemia (24%), renal failure (24%) and cardiac arrhythmia (22%). Patients in the development and validation samples were similar in all variables (p > 0.05) except for birth in a NESB country (development sample 44% vs validation sample 56%, p = 0.006) and diagnosis of chronic cerebrovascular disease (development sample 34% vs validation sample 27%, p < 0.001).

Characteristics of participants by ability to complete the TUG Compared with patients able to complete the TUG, those unable to do so (n = 1358) stayed longer in hospital (median 11 days, IQR 7 to 18 vs 8 days, IQR 5 to 12, p < 0.001). They were older (82.7, SD 8.0, years vs 81.1, SD 7.5 years, p < 0.001) and more likely to be living in...
a nursing home (13% vs 3%, \( p < 0.001 \)). They had more active diagnoses (median 8, IQR 6 to 10 vs 7, IQR 5 to 10, \( p < 0.001 \)) and more often suffered from delirium (42% vs 30%, \( p < 0.001 \)), fracture (21% vs 13%, \( p < 0.001 \)) and stroke (11% vs 7%, \( p = 0.003 \)). They were also more likely to fall during their stay in the Aged Care Unit (10% vs 6%, \( p = 0.004 \)). The two groups were of similar gender (females 62% vs 60%, \( p = 0.33 \)) and were equally likely to be referred from the emergency department (61% vs 60%, \( p = 0.60 \)). TUG data were missing altogether in 173 patients (7.0%).

**Length of stay and TUG** Among those able to complete the TUG, the median length of stay in the Aged Care Unit was 8 (IQR 5 to 12) days. The median TUG time was 28 (IQR 19 to 42) seconds. The lengths of stay (\( p = 0.51 \)) and the TUG times (\( p = 0.22 \)) were similar in the development and validation samples. There was a weak, though significant, relationship between the length of stay and the TUG time (Spearman coefficient 0.18, \( p < 0.001 \), \( n = 932 \)). However, no particular TUG time clearly identified patients with longer lengths of stay. For example, those with TUG times of 29, 43, 68 and 84 seconds (representing percentiles 50, 75, 90 and 95) had median lengths of stay of 8, 9, 8.5 and 9 days, respectively.

The univariate predictors (\( p < 0.05 \)) of length of stay tested for inclusion in the final multivariate Cox model were: referral from the emergency department, use of a mobility aid, presence of a pressure area, serum albumin (all collected on admission), urinary or faecal incontinence, fall during stay in Aged Care Unit, overall co-morbid disease, and diagnoses of delirium, dementia, depression, fracture, ulcer, infection and stroke (all collected during stay in Aged Care Unit). The variables were removed from the model in the following order: delirium, albumin, dementia, use of a mobility aid, presence of a pressure area, urinary or faecal incontinence, stroke, and fracture. Table 1 shows the final multivariate Cox proportional hazards models. The adjusted hazard of discharge from the Aged Care Unit (and hence the hospital) decreased by 15–19% for each unit change in the log TUG time (Table 1). The model accounted for about 17% of the variance in length of stay.

**Discussion** The admission TUG time failed to clearly identify older in-patients with longer lengths of stay. However, less than 40% of patients were able to complete the TUG. Those unable to complete the TUG had median lengths of stay 40% or so longer than those able to complete the TUG, suggesting that the value of the TUG as a screening test lies in determining whether patients can complete it, rather than the time taken to complete it.

While the TUG incorporates a series of tasks important for independent mobility (standing from a seated position, walking, turning, stopping and sitting down), only the time taken to complete the test is measured. Problems with any particular task may be masked and the opportunity to address a specific deficit may be missed. Other simple tests of basic mobility that depend on a global measure, such as usual gait speed, will have similar limitations. While usual gait speed does not incorporate the turning and sitting components that appear to be particularly difficult in older persons (Wall et al 2000), it may allow more complete data utilisation by giving those unable to mobilise a score of zero.

Our referrals from the emergency department had shorter lengths of stay, while patients who fell in the Aged Care Unit, those with diagnoses of depression, skin ulceration and infection, and those with greater medical co-morbidity stayed longer (Table 1). Patients admitted through the emergency department usually have rapid access to diagnostic services, allowing earlier and more accurate management decisions. When specialist doctors were consulted (19% of all admissions), those admitted through the emergency department were seen faster (mean 2.4 vs 3.1 days per consult, \( p = 0.04 \)). Earlier consultation and rapid access to diagnostic services probably shortened lengths of stay in this group. In-patient falls (Kozyrskyi et al 2002), depression (Aoki et al 2003), skin ulceration (Gruen et al 1996) and infection (primarily nosocomial) (Sheng et al 2005) have all been shown to increase length of stay, with longer lengths of stay also allowing more nosocomial infections to develop (Dulworth and Pyenson 2004). Excessive medical co-morbidity causes physical disability (Fried et al 1999), decreases rehabilitation efficiency (Patrick et al 2001), promotes use of inappropriate medications (Onder et al 2003), and increases likelihood of delirium (Mincione et al 2000) and depression (Crabtree et al 2000). In turn, these increase length of stay, both independently and through interactions with each other. Considering the many variables that affect length of stay, some of which are difficult to measure, the strong association between length of stay and the inability to complete the TUG is rather surprising. The latter is quick and easy to measure, and therefore potentially useful for screening purposes and for casemix-adjusted funding models for older persons.

A limitation of this study is that the length of stay was defined as the number of days in the Aged Care Unit, and not the total duration of hospitalisation, as multidisciplinary data collection was only feasible when patients came to the Aged Care Unit. Patients transferred from other services clearly had longer hospital lengths of stay, and an Aged Care Unit bed was not always available on the day of admission for those referred from the emergency department. However, the median time from admission to the hospital and transfer to the Aged Care Unit was only one day in both the validation and development samples. Another limitation is that the population of older patients at risk of prolonged length of stay is larger than our study population suggests, particularly as we used geriatric targeting criteria to admit patients. Consequently, our results cannot be easily generalised to other high-risk patient groups.

This study has identified the TUG times expected among targeted, acutely unwell older in-patients, and complements the measures recently reported by Lindsay et al (2004). Less than 40% were able to complete the TUG. The admission TUG time should not be used to screen for patients likely to have longer lengths of stay. The value of the TUG lies in determining the patient’s ability to complete it, rather than the time taken to complete it.

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