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Title: **Should elderly patients be screened for their 'falls risk'? Validity of the STRATIFY falls screening tool and predictors of falls in a large acute hospital.**

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Running heading: Routine screening for falls risk

Sir,

Falls are not uncommon in hospitals settings with rates between 1.3% and 12.2% of all admissions [1-3] in acute facilities. Approximately 6% of falls result in serious injury such as bleeding or laceration, fracture and haematoma [4, 5]. Falls in hospital may lead to prolonged length of stay [6] or litigation [7]. Unfortunately, studies of interventions to prevent hospital-related falls are limited or of low quality [8] and provide no conclusive evidence that falls, in acute facilities, can be reduced through falls prevention programs [9, 10,11].

Despite this, screening to identify patients who may be at risk of falling is widespread. For example, recent Australian guidelines [12] recommend screening and assessment of all older people for risk of falling using the St Thomas' Risk Assessment Tool (STRATIFY tool) [13]. However, published studies about the ability of the STRATIFY tool to discriminate accurately between those with and without a high risk of falling [14-18] have been contradictory (see Table 1). In addition, recent systematic reviews of fall screening tools have urged caution with their use because of their tendency to over-classify patients as high risk, leading to poorly targeted interventions [19-21]. The aim of the current study was to test the validity of the tool in our own setting, before introducing it as standard practice.

METHODS

Population

We included in-patients from a 982 bed general, tertiary referral teaching hospital with a number of specialities including medicine, surgery, orthopaedics, psychiatry, oncology,

gynaecology, and trauma services. We obtained Human Research Ethics approval to extract follow-up data from patient records.

Instrument

The STRATIFY tool consists of five items assessing: previous falls, agitation, visual impairment, toileting frequency, and transfer/mobility needs using the Barthel scoring system. Each item is scored with 1 for ‘yes’ or 0 for ‘no’; loadings are not used, giving each risk equal value. A score 2 or greater is used to determine a high risk of falling [12].

Procedure

Patients 65 years and older were assessed within 48 hours of admission by trained research officers. Falls incidence was assessed from the ‘Patient Incident Reports’ data base and by extracting any falls related data from the patient’s case notes. Any fall- related modifications made to the patient’s management were documented.

Analysis

We used a fall defined as: ‘an event which results in a person coming to rest inadvertently on the ground or floor or other lower level’ as the primary outcome. Data were entered and analysed using SPSS version 15.0. A Fisher’s exact (2-sided) test or an independent samples *t*-test was used to examine group differences in categorical and continuous data respectively. Sensitivity (the proportion of fallers correctly classified as high risk of falling), specificity (the proportion of fallers correctly classified as low risk of falling), positive predictive values (PPV the proportion of those classified as high risk who fell) and negative predictive values (NPV proportion of those classified as low risk who did not fall) [8] were calculated using the recommended cut-off point of $\geq$2 for the STRATIFY tool analysis. We also calculated the Youden Index [22] and the total predictive accuracy; both of which

measure how well the STRATIFY risk score predicts falls. For both calculations, a score close to one indicates high predictive accuracy. Predictors of falling were identified using binary logistic regression. The patient was used as the unit of analysis, irrespective of the number of falls.

RESULTS

Between 17th March and 24th October 2007, 788 patients were screened for falls risk. Participants were surgical (41.5%) medical (41.2%), oncology (7.0%), extended stay or geriatric assessment and rehabilitation (GARU) (5.6%) or mental health (4.7%). The mean age was 77.7 years [standard deviation (SD) 7.91)] and the mean length of stay was 27.7 days (range 1 – 224 days; SD 31.68). Three hundred and eighty nine (49.4%) of the participants were male, 260 (32.6%) had experienced a previous fall, 178 (22.6%) were classified as ‘agitated’, 152 (19.3%) were visually impaired, 232 (29.4%) required frequent toileting and 305 (38.7%) had a transfer/mobility risk. The STRATIFY tool classified 335 (42.5%) patients as being a ‘falls risk’.

Seventy two (9.1%) of patients had a fall. Thirty nine (54.2%) occurred beside the bed, 20 (27.8%) in the bathroom and 13 (18.1%) in a variety of other ward areas. Of the 335 patients classified as being ‘at risk’ for falling, 59 (17.6%) did so, compared to 13 of 453 (2.9%) who were not at risk ($P<0.001$) (sensitivity 0.82; 95% CI: 0.71, 0.90), specificity 0.62; 95% CI: 0.58, 0.65), PPV 0.18; 95% CI: 0.14, 0.22), NPV 0.97; 95% CI: 0.95, 0.98)). Accuracy of the STRATIFY, measured by the overall total predictive accuracy and the Youden Index, was moderate (0.63 and 0.44 respectively). When accuracy was analysed by patient mix, the total predictive accuracy was highest among mental health patients (0.86) and lowest in the GARU and long stay patients (0.52). Accuracy using the Youden Index was highest for

oncology patients (64.7) and lowest for surgical patients (36.8). Crude odds ratios and 95% confidence intervals for the five STRATIFY risk factors and three demographic factors are given in Table 2. Statistically significant factors were entered simultaneously into a binary logistic regression model predicting falls. Having a previous fall [odds ratio (OR): 2.95; 95% CI: 1.68, 5.19)], being agitated (OR: 1.82; 95% CI: 1.02, 3.23), having a transfer and mobility risk (OR: 2.63; 95% CI: 1.47, 4.71) and length of hospital stay (OR per day: 1.019; 95% CI: 1.012, 1.025) were significant predictors of falling in this cohort ($P<0.05$) (Table 2).

DISCUSSION.

This is the first study to investigate the validity of the STRATIFY falls tool in an acute, in-patient mix including medical, surgical, mental health and oncology patients. It is timely given that the tool has been recommended for use in such populations. Consistent with other reports [15, 17, 18] and several systematic reviews [19-21], we found that the STRATIFY tool is an inadequate strategy for identifying those who may be at risk of falling in hospital settings. Although the STRATIFY was able to correctly identify those who would not fall, neither the tool as a whole, nor individual items, was able to discriminate well between those who later fell or did not fall. This was true of all in-patient groups; even though we had expected a much higher predictive accuracy among our GARU and long stay medical patients.

There were some limitations to the study. We did not conduct any formal inter-rater reliability testing among the four research nurses who collected data. However, there was extensive discussion and agreement about the meaning of questionnaire items, so we do not expect that this would have affected outcomes. Our follow-up processes

were quite rigorous; even so, there is a possibility that falls were not recorded either on the hospital's electronic database or in the patient's medical record leading to under-reporting of the falls rate. The other limitation was the small number of patients in the clinical areas of oncology, GARU/long stay medical and mental health. Results from these areas were similar to from our larger cohorts, providing some confidence that these results are meaningful.

To be operationally useful, a falls screening tool would require a predictive accuracy above 80%. In our setting, the tool had a high sensitivity and negative predictive value and a moderately high specificity, providing reassurance about patients at low risk; however, the more important statistic for health care facilities is the positive predictive value, or the ability to identify patients who will fall. In our sample, 82% of patients who were classified as high risk using the STRATIFY did not fall; which is far too high to make it clinically useful. The purpose of screening for falls risk is to identify those at high risk so that further, multi-disciplinary assessment may be made. Routine use of the STRATIFY, with such a high false positive rate, would have considerable implications for hospital resources and may lead to poorly targeted interventions.

One of the reasons for a low predictive validity of the STRATIFY in acute hospitals is that the positive predictive value is a statistic dependent on the prevalence of the reference event, in this case falls. Data from our hospital shows this clearly in Table 1. Fall rates between specialty groups ranged between 6.1 and 15.9 and, with the exception of the mental health cohort, positive predictive values reflected these rates.

After controlling for inter-relationships among the risk factors, two of the STRATIFY variables (visual impairment and frequent toileting) failed to maintain statistical significance. Similar findings, particularly in relation to visual impairment have been reported by other investigators [14, 23]. Of the risk factors remaining predictive after adjustment, the strongest were having a history of falling, having a high transfer/mobility score and length of hospital stay. Apart from the latter, these factors are generally known on admission, without recourse to the use of a falls risk screening tool. Perhaps a way forward would be to fully assess all patients with a history of falling and those with a high transfer/mobility risk and ensure that they receive evidence based interventions; such as close observation [24]. There is also an urgent need to test other, novel interventions in acute hospital settings.

CONCLUSION

The STRATIFY falls risk tool was significantly related to incidence of accidental falls in this large cohort but was a poor predictor of falls and cannot be recommended for routine use in acute hospital settings.

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Table 1. Validity of the STRATIFY falls risk assessment tool in various settings

Study	Year	Falls rate	Setting	Mean age in years	Sensitivity	Specificity	PPV*	NPV†
Oliver[12] (n = 217)	1987	32.7	Elderly acute care hospital unit	79.5	93.0	87.7	62.3	98.3
Oliver[12] (n = 331)	1987	23.9	Elderly care wards	83.0	92.4	68.3	38.8	48.8
Chiari[14] (n = 1181)	2002	11.3			20.0	87.0	14.6	90.7
Coker[15] (n = 581)	2003	25.7	Geriatric assessment and referral unit	81.0	65.8	46.7	29.9	79.8
Vassallo[16] (n = 135)	2005	16.3	Medical wards	83.8	68.2	66.4	28.3	91.5
Wijnia[13] (n = 120)	2006	30.0	Nursing home	74.5	50.0	76.2	47.4	78.0
Smith[17] (n = 225)	2006	30.0	Stroke patients	78.0	11.3	89.5	25.0	76.6
Webster (n = 788) ‡	2008	9.1	Acute tertiary hospital (overall)	77.7	81.9	61.5	17.6	97.1
		6.1	Surgical patients (n=327)	76.9	70.0	66.8	12.1	97.2
		11.7	Medical patients (n=325)	79.2	84.2	54.4	19.6	96.3

		7.3	Oncology patients (n= 55)	73.7	100.0	64.7	18.2	100.0
		15.9	GARU & long stay medical (n=44)	80.5	100.0	43.2	25.0	100.0
		8.1	Mental health patients (n=37)	73.1	66.7	88.2	33.3	96.8

* Positive predictive value

† Negative predictive value

‡ For comparative purposes, our results are shown here as percentages

Table 2. Predictors of falling among a cohort of patients over 65 years in an acute hospital setting

Predictors of falling	Univariate analysis		
	OR*	95% CI†	*P*‡
Male gender	1.23	0.76, 2.01	0.39
History of a previous fall	4.85	2.90, 8.13	<0.001
Patient agitated	2.74	1.66, 4.53	<0.001
Visually impaired	1.98	1.16, 3.39	0.011
Requiring frequent toileting	2.82	1.73, 4.61	<0.001
Transfer and mobility risk	3.57	2.14, 5.97	<0.001
Age	1.036	1.003, 1.070	0.034
Length of hospital stay (days)	1.022	1.016, 1.028	<0.001
	Binary logistic regression analysis		
History of a previous fall	2.95	1.68, 5.19	<0.001
Patient agitated	1.82	1.02, 3.23	0.042
Visually impaired	1.41	0.75, 2.64	0.28
Requiring frequent toileting	1.71	0.97, 3.01	0.065
Transfer and mobility risk	2.63	1.47, 4.71	0.001
Length of hospital stay (days)	1.019	1.012, 1.025	<0.001

* Odds Ratio

† Confidence intervals

‡ Level of significance