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Brief Report

Use and clinical efficacy of standard and health information technology fall risk assessment tools

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Objective: *To evaluate the health information technology (HIT) compared to Fall Risk for Older Persons (FROP) tool in fall risk screening.*

Methods: *A HIT tool trial was conducted on the geriatric evaluation and management (GEM, n = 111) and acute medical units (AMU, n = 424).*

Results: *Health information technology and FROP scores were higher on GEM versus AMU, with no differences between people who fell and people who did not fall. Both score completion rates were similar, and their values correlated marginally (Spearman's correlation coefficient 0.33, P < 0.01). HIT and FROP scores demonstrated similar sensitivity (80 vs 82%) and specificity (32 vs 36%) for detecting hospital falls. Hospital fall rates trended towards reduction on AMU (4.20 vs 6.96, P = 0.15) and increase on GEM (10.98 vs 6.52, P = 0.54) with HIT tool implementation.*

Conclusions: *Health information technology tool acceptability and scoring were comparable to FROP screening, with mixed effects on fall rate with HIT tool implementation. Clinician partnership remains key to effective tool development.*

Practice Impact: The health information technology tool, incorporating iPad™ and automatically generated visual cues, was created in partnership with hospital clinicians. It represents a viable technology alternative to poorly received bedside posters and is comparable in accuracy and acceptability to existing falls risk assessment tools, in targeting falls risk among inpatients.

Key words: *accidental falls, electronic health records, patients, risk assessment, technology.*

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Introduction

Falls in hospitals are common and result in significant morbidity, mortality and health-care utilisation [1]. The reported fall incidence is rising [2], possibly representing improved reporting and/or altered patient profiles [2]. To address this problem, many hospitals screen for fall risk with fall risk assessment tools [3–5]. The evidence from systematic reviews, however, is inconsistent for their validity and accuracy, with mixed results for screening tools' efficacy in reducing falls [3–5]. Thus, there is the need to develop accurate and effective fall risk screening measures.

The Fall Risk for Older Persons in the Community (FROP-Com) assessment tool is validated for screening fall risk among emergency department patients aged 65+ years [6]. The abbreviated 3-item FROP is currently utilised as mandatory paper-based screening at The Queen Elizabeth Hospital (TQEH), with scores ≥4/9 selected as the cut-off to trigger staff implementation of fall-preventive measures [7].

The use of modern health technology, such as a fall prevention toolkit incorporating electronic health record (EHR), bedside posters, patient education and care plans [8], would seem to have potential to improve the value of fall risk screening and management, but there are inadequate data on the efficacy and staff uptake of this form of technology [9].

We hypothesised health technology would support best practice fall prevention. Mindful of negative staff feedback on the usability of existing paper posters using coloured adhesive dots to indicate fall risk, and with a new EHR system due to roll-out statewide, we collaborated with clinicians at the geriatric evaluation and management (GEM) unit at TQEH in Adelaide, South Australia, to develop a health information technology (HIT) tool to support direct iPad™ entry of clinicians' judgement of patients' fall risk. Research objectives were to evaluate HIT tool acceptability, correlation with FROP, accuracy and clinical efficacy, to guide further tool refinement.

Methods

Ethics approval was received from the Human Research Ethics Committee of Basil Hetzel Institute (HREC/13/TQEHLMH/66). The study was conducted over consecutive 12-week periods on acute medical unit (AMU; September–November 2014), managing patients with acute illness; and GEM unit (June–August 2014), providing subacute rehabilitative care for patients predominately extracted from AMU at TQEH. All patients admitted to both wards during the trial period were included, with GEM information alone analysed for those initially admitted to AMU.

The responsible clinician carried the iPad™ and directly entered patients' details and their personal judgement of day- and night-time fall risk for 13 movement and location types, with total fall risk items equating HIT score out of 13 (high-risk defined as ≥12/13 as per maximal sensitivity and specificity for falls). Black-and-white A4-sized visual cues (i.e. bedside posters) were automatically printed at assessment completion, and the same clinician displayed these by patient's bedside, with the eventual aim to incorporate these into EHR. GEM staff utilised the full six weeks of researcher-led training and chose to use the HIT tool on admission and where fall risk changed (e.g. postfall), while AMU staff declined training after one day, due to staff confidence using the HIT tool, and utilised it daily on all patients. FROP evaluation continued as standard procedure on ward admission.

Health information technology and FROP scores were recorded at admission. The following outcomes were looked at:

Acceptability: average percentage of fortnightly HIT and FROP score completion rates, over total patient numbers.

Correlation of HIT and FROP scores: average percentage of similar fall risk factors identified on HIT (requirements for walking aid, supervision in toilet/shower/corridor) and FROP screening (falls, function, balance); and correlation between HIT and FROP scores.

Clinical efficacy: hospital fall rates (i.e. total inpatient falls per 1000 occupied bed-days (OBD; total beds occupied multiplied by total days occupied [10])) recorded by hospital incident reporting systems, before (two-week period), during (12-week period) and after (two-week period) HIT tool trial.

Accuracy: sensitivity, specificity, positive likelihood ratio (PLR) and negative likelihood ratio (NLR), positive predictive value (PPV) and negative predictive value (NPV) and area under the curve (AUC) measurements of high-risk HIT (defined as ≥12/13 as per maximal sensitivity and specificity) and FROP (previously defined as ≥4/9 [7], as per maximal sensitivity and specificity) scores in detecting hospital falls.

Patient and fall data, HIT and FROP score values, correlation and accuracy were presented as descriptive statistics. Independent t-testing compared mean values, chi-square analysis compared proportions and Spearman's correlation evaluated the association between scores ($P \leq 0.05$). Sensitivity, specificity and likelihood ratios were obtained for HIT and FROP tools. Statistical analysis was performed using SPSS 10 and MedCalc Statistical Software version 16.4.3.

Results

Patient characteristics

Compared to AMU patients ($n = 424$), GEM patients ($n = 111$) were older; had longer lengths of stay; and had greater incidence of walking aid use, polypharmacy and geriatric syndromes (Table 1).

HIT and FROP score values

There were no differences between people who fell and people who did not fall for HIT (9.92 ± 4.47 vs 10.00 ± 4.40, $P = 0.12$) and FROP scores (4.50 ± 2.78 vs 4.50 ± 2.77, $P = 0.65$). GEM patients had higher mean HIT (11.57 ± 2.71 vs 9.50 ± 4.77, $P < 0.01$) and FROP scores (5.47 ± 2.16 vs 4.20 ± 2.83, $P < 0.01$) than AMU patients (Items 1 and 2; Table 1).

Acceptability of HIT assessments

Fall risk for older persons and HIT score completion rates were equivalent (70 vs 63%, $P = 0.47$), with HIT score completion rates trending higher on GEM compared to AMU (70 vs 61%, $P = 0.08$; Item 1; Table 2).

Correlation between HIT and FROP scores

HIT and FROP screening agreed on half the same fall risk items, and scores correlated marginally (Spearman's correlation coefficient 0.33, $P < 0.01$; Item 2; Table 2).

Accuracy of HIT and FROP scores

HIT scores ≥4/9 and FROP scores ≥12/13 demonstrated greatest combined sensitivity and specificity for detecting hospital falls (sensitivity 80 vs 82%, specificity 32 vs 36%). HIT scores demonstrated higher PLR (0.89, 1.35); higher NLR (1.33, 0.49); and similar PPV (1, 2%), NPV (98, 99%) and AUC (0.55, 95% confidence interval (CI) 0.38–0.71; 0.50, 95% CI 0.34–0.67) as FROP scores (Item 3; Table 2). There was reduced predictive value for falls for both scoring systems.

Clinical efficacy of HIT scores

There was a trend towards reduced hospital fall rates on AMU (pretrial vs post-trial 8.80 vs 4.20 falls per 1000 OBD, $P = 0.15$), and higher rates on GEM (5.98 vs 10.98, $P = 0.54$; Item 4; Table 2) with HIT tool implementation, although these values did not reach statistical significance. One-third of hospital fall incident data were incomplete for details of patient and fall.

Table 1: Comparison of patient characteristics on acute medical unit and geriatric evaluation and management wards

	Total (n = 535)	AMU (n = 424)	GEM (n = 111)	P-value (AMU vs GEM)
HIT score (week 1), mean ± SD	10.00 ± 4.48	9.52 ± 4.74	11.57 ± 2.68	<0.01*
People who fell	11.57 ± 3.37	10.86 ± 4.81	12.29 ± 0.49	
People who did not fall	9.92 ± 4.47	9.47 ± 4.75	11.50 ± 2.82	
P-value (people who fell vs people who did not fall)	0.12	0.36	0.43	
FROP score (week 1), mean ± SD	4.50 ± 2.77	4.26 ± 2.86	5.40 ± 2.18	<0.01*
People who fell	4.20 ± 2.68	N/A due to lack of data	4.20± 2.68	
People who did not fall	4.50 ± 2.78	4.26 ± 2.86	5.56 ± 2.12	
P-value (people who fell vs people who did not fall)	0.65	N/A	0.09	
Gender, *n* (%)				
Female	323 (60)	251 (59)	72 (65)	0.16
Male	208 (39)	171 (40)	37 (33)	
Age, in years (mean ± SD)	75.44 ± 14.60	76.22 ± 15.50	85.02 ± 6.01	<0.01*
Medications, *n* (%) (Number (proportion) with polypharmacy, defined as ≥5 discharge medications [16])	400 (75)	303 (71)	97 (87)	<0.01*
Function, *n* (%)				
Walking aid preadmission	368 (69)	268 (63)	100 (90)	<0.01*
Walking aid during admission	392 (73)	292 (69)	100 (90)	<0.01*
Presenting problem, *n* (%)				
Falls	137 (26)	82 (19)	55 (50)	<0.01*
Functional decline	45 (8)	18 (4)	27 (24)	<0.01*
Delirium	71 (13)	44 (10)	27 (24)	<0.01*
Cognitive and behavioural	40 (7)	28 (7)	12 (11)	0.01
Pain	99 (19)	78 (18)	21 (19)	0.99
Infection	278 (52)	217 (51)	61 (55)	0.02*
Charlson Comorbidity Index (mean ± SD) [17]	6.26 ± 2.66	6.19 ± 2.81	6.62 ± 1.99	0.140
Length of stay, in days (mean ± SD)	9.63 ± 11.31	6.54 ± 6.17	21.04 ± 16.93	<0.01*
Place of residence on admission, *n* (%)				
Home	457 (85)	351 (83)	106 (96)	<0.01*
Residential care	70 (13)	67 (16)	3 (3)	<0.01*
Place of residence on discharge, *n* (%)				
Home	295 (55)	239 (56)	57 (51)	0.99
Residential care	79 (15)	65 (15)	13 (12)	0.91
Other hospital or ward	100 (19)	77 (18)	4 (4)	0.01*
TCP	21 (4)	0 (0)	21 (19)	<0.01*
Respite	6 (1)	1 (0)	5 (5)	<0.01*
Death	20 (4)	15 (4)	4 (4)	1.00

*$P < 0.05$, that is significant. AMU, acute medical unit; GEM, geriatric evaluation and management; HIT, health information technology; N/A, not applicable; SD, standard deviation; TCP, transitional care posthospitalisation (short-term care services for restoring independence to older persons posthospitalisation [18]).

Discussion

The HIT tool demonstrated similar acceptability, score correlation and accuracy in predicting hospital falls as FROP, although predictive value for both scoring systems was poor. With the benefits of technology and automatically generated visual cues, the HIT tool represents a viable alternative to existing paper-based fall risk screening, which has been poorly received and used by health-care staff.

Clinicians' acceptability of the HIT tool trended higher on GEM compared to AMU, possibly due to longer staff training period, and greater senior nursing endorsement and involvement in tool design. Systematic review evidence has shown staff engagement and leadership support to be crucial to successfully implementing fall-preventive strategies [9].

Suboptimal HIT tool use may have been due to reduced clinicians' confidence in its use and efficacy [11]. By comparison, incomplete FROP and fall incident reporting supports previous research that 64% of mandatory hospital admission fall risk assessments [12] and 75% of hospital fall incidents [13] are recorded in Australia.

HIT and FROP scores did not distinguish between people who fell and people who did not fall. There was a reduced hospital fall rate on AMU with HIT tool implementation, although this did not achieve statistical significance, with opposing effect on GEM. Potential reasons for the mixed effect included staff (e.g. level of clinical experience in implementing preventive strategies) and patient-related factors (e.g. frailty) not accounted for in study analysis.

Table 2: Fall risk for older persons and health information technology score completion rates, correlation, accuracy and clinical efficacy on acute medical unit and geriatric evaluation and management wards

Score	Total (n = 540)	AMU (n = 424)	GEM (n = 116)	P-value (AMU vs GEM)
Score completion rates, %				
FROP	70	71	65	0.19
HIT	63	61	70	0.08
P-value for FROP versus HIT completion rates	0.47	0.53	0.88	N/A
Correlation of HIT and FROP scores				
Average percentage of similarly identified fall risk factors, %	55	44	66	0.30
Spearman's correlation for FROP and HIT scores, P-value	0.33, <0.01*	0.39, <0.01*	−0.01, <0.01*	N/A
	FROP score (≥4/9)	AMU (falls/1000 OBDs)		HIT score (≥12/13)
Accuracy				
Sensitivity (95% CI)	80 (28–99)			67 (9–99)
Specificity (95% CI)	41 (35–47)			25 (20–31)
Positive likelihood ratio (95% CI)	1.35 (0.86–2.12)			0.89 (0.40–1.98)
Negative likelihood ratio (95% CI)	0.49 (0.08–2.84)			1.33 (0.27–6.70)
Positive predictive value (95% CI)	2 (1–4)			1 (0–2)
Negative predictive value (95% CI)	99 (95–100)			99 (93–100)
Area under curve (95% CI)	0.55 (0.38–0.71)			0.51 (0.34–0.67)
Falls/1000 OBD				
Pretrial	7.23	8.80		5.98
Trial	6.71	6.96		6.52
Post-trial	8.00	4.20		10.98
P-value (trial vs pretrial)	0.58	0.84		0.80
P-value (trial vs post-trial)	0.32	0.15		0.54

*P < 0.05, that is significant. AMU, acute medical unit; CI, confidence interval; FROP, Falls Risk for Older Persons; GEM, geriatric evaluation and management; HIT, health information technology; N/A, not applicable; OBD, occupied bed-days.

Our findings support systematic review evidence that current screening tools are inadequate for predicting falls among older patients [3–5], possibly due to clinical fluctuations among this cohort [3], lack of inclusion of relevant risk factors [14] and need for local adaptation of screening tools [15]. It remains unclear whether improving tool accuracy would reduce fall rates.

Strengths and limitations

This study adds to the limited knowledge on the acceptability and clinical efficacy of a HIT in fall risk screening and management. The ongoing clinician partnership has refined the design and use of the HIT tool design. Study limitations included single-hospital setting and incomplete score and fall incident reporting, which further highlights the importance of clinician collaboration in developing acceptable, effective fall risk screening tools.

Conclusion

The HIT tool represents a fall risk screening technology tool developed in partnership with clinicians and comparable in acceptability, scoring and accuracy to mandatory FROP screening. HIT tool use was higher on the subacute ward, which had greater leadership endorsement and staff involvement in tool design. Our study highlighted the challenges of inpatient fall risk screening (incomplete reporting, low predictability for fall and mixed effects on hospital fall rates) and informed HIT tool refinement for future implementation.

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