Critical Review Form
Prognosis

Identifying older-people at high risk of future falls: development and validation of a screening tool for use in EDs, *Emerg Med J* 2013; 30: 918-922

Objective: "To develop, and externally validate a simple fall risk screening tool for use in the ED. We also aimed to compare the predictive ability of the developed tool to a simple question about previous falls and to existing screens for use in this setting." (p. 919)

Methods: Patients aged 70 or older presenting to one or two Sydney Australia EDs due to a fall or with a history of two or more falls in the past year were eligible. Exclusion criteria included minimal English language skills, nursing home resident, or cognitive impairment with no live-in caregiver. Data for the study (medical history and physical exam) were obtained by the Aged-Care Services in Emergency Team who received regular maintenance training sessions on administering the physical assessment measures: standing balance, near tandem standing performance, chair rise, alternate step test, and the timed up and go test.

The primary outcome was any fall at 6-months, defined as unintentionally coming to rest on the ground or other lower surface without overwhelming external force or a major internal event. Fall occurrence was measured using a monthly falls diary and telephone follow-up, as required. Since 7-59% of physical exam tests were missing (patient could not or would not perform), patients with missing data were allocated scores that were two standard deviations worse than the total sample average performance.

Univariate associations between potential predictor variables and falls were assessed using binary logistic regression. Continuous predictor variables with $p \leq 0.05$ were dichotomized at the median integer value. Candidate predictor variables had odds ratio > 1.5 and $p \leq 0.2$ for multivariate logistic regression models, ensuring at least 10 fall-cases per predictor. ROC AUC was used to quantify the ability of the model to distinguish fallers from non-fallers and calibration was assessed using the Hosmer-Lemeshow statistic.

Guide		Comments
I.	**Are the results valid?**	
A.	**Was the sample of patient's representative?** *In other words, how were subjects selected and did they pass through some sort of "filtering" system which could bias your results based on a Non-representative sample. Also, were objective criteria used to diagnose the patients with the disorder?*	Yes, as noted in Table 1 (p. 919), patients in the derivation and validation sets were on average 81 years old with 27%-46% male, and a significant proportion suffered from age-related co- morbidities of arthritis, heart disease, hypertension, stroke, Parkinson's disease, diabetes, self-reported visual impairment, and hearing impairment.
B.	**Were the patients sufficiently homogeneous with respect to prognostic risk?** *In other words, did all patients share a similar risk from during the study period or was one group expected to begin with a higher morbidity or mortality risk?*	No, significant differences between derivation and external validation cohorts noted in the prevalence of heart disease (35% vs. 17%), hypertension (62% vs. 42%), stroke (14% vs. 13%), diabetes (23% vs.13%), visual impairment (45% vs 13%) or hearing impairment (28% vs. 6%). It appears that the derivation set were overall a sicker, frailer subset of patients than were the validation set. However, this is not reflected in the fall rates: 31% derivation set vs. 35% in validation set.
C.	**Was follow-up sufficiently complete?** *In other words, were the investigators able to follow-up on subjects as planned or were a significant number lost to follow-up?*	Unknown. "of the 219 people enrolled in the study, seven (two men, five women) withdrew from the study, and six (three men, three women) were unable to be contacted prior to completing at least two months of follow-up and so were not included in further analysis. These 13 excluded people did not differ significantly from the remaining sample in terms of age and sex." (p 919). Thus, 6% of enrolled were lost to 2-month follow- up. However, this was a 6-month study – how many completed all 6- months of follow-up? Also, 11.2% of validation set did not complete at least 2-months of follow-up.

D.	**Were objective and unbiased outcome criteria used?**	Yes, falls were explicitly defined using an accepted definition. Also, fall diaries were used similar to other studies. However, geriatric patients often forget falls and this study design may under-report true fall incidence.
II.	**What are the results?**	
A.	**How likely are the outcomes over time?**	• At 6-months 31% of derivation set and 35% of validation set experienced at least one fall (15% one fall, 8% two falls, 9% three or more falls). • 62% of falls were injurious: bruises > cuts > sprains > fractures. Only 2% resulted in fractures. • Six variables were entered into the multivariate regression model: living alone, needing home assistance from community services, taking 6+ medications, self-reported depression, 2+ falls in previous year, and use of walking aid outdoors. • The multivariate logistic regression model selected three variables as significant, independent predictors of falls: 2+ falls in the previous year (OR 4.95, 95% CI 2.58 to 9.51), taking 6+ medications (OR 1.80, 95% CI 0.94 to 3.46), and use of a walking aid outdoors (OR 1.71, 95% CI 0.90 to 3.27). The AUC was 0.73 (95% CI 0.66 to 0.81) for the derivation set.

A.	**How likely are the outcomes over time?**	• The odds ratios for the association of faller status and predictor variables were **previous multiple falls** (OR 4.02, 95% CI 1.92-8.41), **taking 6+ medications** (OR 2.31, 95% CI 1.09-4.89) and **walking aid use indoors** (OR 0.76, 95% CI 0.36-1.59). Since walking aid use was not a significant predictor, it was removed from the final model. In addition, in order to weight "multiple past falls" in accordance with the observed odds ratio a positive response was given a score of 2 compared to 6+ meds which was scored 1. • On the total cohort of derivation and validation patients a Tiedemann score of 0 corresponds to a 16% probability of falling, 1=28%, 2=44%, 3=61% (Table 3, p. 921). • The Hosmer-Lemeshow test did not detect a lack of fit (p=0.71) • The authors report ROC AUC for Tiedemann of 0.67 (0.62-0.72) which compares favorably with FROP-COM (AUC 0.73) and PROFET (AUC 0.70) • Interval LRs for Tiedemann score are: 0 to 1 = 0.4 1 to 2 = 0.7 2 to 3 = 1.6 >3 = 3.6 • **None of the physical exam assessments predicted falls**, including standing balance (OR 0.96), timed up and go (OR 0.99), sit to stand (OR 1.00), unable to do near tandem stand (OR 1.44), or alternate step test (OR 0.99).

B.	**How precise are the estimates of likelihood?** *In other words, what are the confidence intervals for the given outcome likelihoods?*	See 95% CI above.
III.	**How can I apply the results to patient care?**	
A.	**Were the study patients and their management similar to those in my practice?**	No. The authors used the "Aged Services in Emergency Team" to query patients about fall risk and to perform functional tests. These distinct providers do not exist in the large majority of EDs in the United States and it is uncertain whether their presence altered the detection of fall risk or the natural course of disease in 6-month falls. In addition, the authors compare their new instrument to FROP-COM (which they acknowledge has never been evaluated in ED settings) rather than the instruments that have been tested in the ED (Carpenter 2009)
B.	**Was the follow-up sufficiently long?**	No – see response above for Question IC. The authors report loss to follow-up at 2-months but this is a 6-month study. By contrast Carpenter et al reported 39% lost to complete 6-month follow-up, which these authors appropriately critique – but what % of patients in the current study completed 6-months of follow-up? They don't report.
C.	**Can I use the results in the management of patients in my practice?**	No, because the Tiedemann instrument awaits external validation and the iLRs do not significantly increase or decrease post ED fall risk.

Limitations

1) **No reliability results reported (inter-rater Kappa).**

2) **Awaits external validation.**

3) **Use of Aged Care Services in Emergency Team limits external validity.**

4) **Inadequate reporting of lost to follow-up; the authors needed to report the proportion that completed all 6-months of follow-up, not those who completed at least 2-months.**

5) **Failure to reference or use CDR methodology.**

6) **Failure to compare prognostic accuracy with other instruments derived in similar ED settings.**

7) **Failure to report sensitivity/specificity (STARD criteria), although they should be commended for reporting interval LR's.**

8) **Failure to report methods to assess cognitive impairment (dementia, delirium).**

9) **No stratification of accuracy between current fallers and past fallers.**

Bottom Line

The Tiedemann instrument, based on 2 simple ED screening questions, does not significantly increase or decrease fall risk on individual patients who have been to ED for a fall-related compliant or with a history of multiple recent falls. Future ED fall risk instruments need to assess geriatric syndromes (dementia, delirium, frailty) objectively and using readily available ED personnel to ensure external validity and reproducibility. This study also adds to an expanding body of literature suggesting that current objective performance tests (like the timed Get up and Go) in the ED do not accurately predict future falls.