

# Critical Review Form

## Meta-analysis

Predicting Geriatric Falls Following an Episode of ED Care: A Systematic Review, *Acad Emerg Med* 2014; 21: 1069-1082.

**Objective:** “The primary objective of this systematic review was to quantify the accuracy of all existing post-ED assessment fall-risk factors and stratification instruments for use in ED settings. A secondary objective was to estimate test- and treatment-thresholds for fall-risk screening and ED-based preventative interventions based upon the summary estimates of predictive instruments or risk factors derived from this meta-analysis.” (p. 1070).

**Methods:** Using the [MOOSE](#) and [PRISMA](#) reporting guidelines, the authors conducted a medical librarian-assisted electronic search of PubMed, Embase, CINAHL, CENTRAL, DARE, Cochrane Database of Systematic Reviews, and ClinicalTrials.gov from 1950 thru January 2014. Two authors independently reviewed titles and abstracts for potential inclusion and retrieved these manuscripts for full review. In addition, one author conducted a hand-search of annual scientific meeting research abstracts from *Academic Emergency Medicine* and *Annals of Emergency Medicine* from 1990 thru April 2014. Inclusion criteria included reports that recruited general geriatric patients (age $\geq$ 65 years) in ED settings with sufficient detail to reconstruct 2x2 contingency tables using an acceptable definition and assessment of standing level falls within 6-months of the index ED evaluation. Studies evaluating patients exclusively in the hospital or at home following an ED episode of care were excluded. Original study investigators were contacted if published manuscripts did not contain sufficient detail to reconstruct 2x2 contingency tables. *A priori*, the systematic review authors decided to include letters or scientific abstracts, if they included original research data. Non-English manuscripts, [narrative reviews](#), case reports, and studies focused on fall prevention interventions or therapy were excluded.

Two authors independently assessed risk of bias of included studies using the [QUADAS-2](#) instrument. QUADAS-2 statistical agreement between the two reviewers was assessed using a [kappa](#)

**analysis.** These two authors agreed *a priori* on the following criteria while assessing risk of bias using QUADAS-2.

- (1) Fall risk data from patients outside ED settings = high risk of **spectrum bias**.
- (2) Fall risk data obtained from research personnel (rather than ED nurses or physicians) = high risk of **conduct applicability bias** (low external validity for real-world settings).
- (3) Failure to explicitly mask outcome assessors to fall-risk screening instrument results or interpretation = high risk of **incorporation bias**.

Meta-analysis was planned if more than one study assessed the same fall risk factor using similar fall outcomes & definitions at the same follow-up interval. The authors used a **random-effects model** and assessed **inter-study heterogeneity** of pooled estimates of prognostic accuracy using the **Index of Inconsistency**, Cochran's Q, and tau-square. The authors also reported a theoretical test-treatment

Guide	Question	Comments
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threshold using the **Pauker & Kassirer decision threshold model**.

I	<i>Are the results valid?</i>	
1.	Did the review explicitly address a sensible question?	Yes, what is the accuracy for commonly cited fall risk factors to predict subsequent falls amongst older adults following an episode of ED care?
2.	Was the search for relevant studies details and exhaustive?	Yes. In addition to employing a medical librarian to devise the search strategy (see Data Supplement S1), the authors reviewed six distinct electronic resources (PubMed, Embase, CINAHL, CENTRAL, DARE, Cochrane Database of Systematic Reviews, and ClinicalTrials.gov) and conducted a hand-search of relevant research abstracts from annual scientific meetings.
3.	Were the primary studies of high methodological quality?	No. Only 3 studies met inclusion criteria and all were both small in number and relied upon patient self-report for the outcome of fall, as well as many of the key predictor variables like dementia and depression. Furthermore, none of the studies referenced or used the <a href="#">STARD criteria</a> and all were at risk for incorporation bias. (p. 1072)

4.	Were the assessments of the included studies reproducible?	Yes. “The authors’ QUADAS-2 assessment of quality had a kappa of 1.0 for exclusions and analysis of all enrolled patients, but could not be performed for the remainder of the domains due to one or both raters labelling all the studies with the same level and certainty of bias (Table 1).” (p 1072)
<b>II. <i>What are the results?</i></b>		
1.	What are the overall results of the study?	<ul style="list-style-type: none"> <li>• Although 601 unique manuscripts &amp; abstracts were identified by the electronic search, only 5 met criteria for full review and only 3 met inclusion criteria after 2 were excluded due to inability to reconstruct 2x2 contingency table &amp; author inability to provide these data.</li> <li>• Incidence of falls in the 6-months after an ED visit was 14% for community-dwelling geriatric patients in the ED for non-fall related complaint and 31% for those in the ED specifically for a fall-related complaint. Of the latter, 17% had &gt;1 fall and 62% of reported falls were injurious.</li> </ul> <p><b>Individual Predictors of 6-month Fall Risk</b></p> <ul style="list-style-type: none"> <li>• Two studies of 660 patients assessed 29 individual fall predictors, including: prior ED use; sociodemographic features; subjective functional mobility; objective tests of gait and balance; self-reported medical diagnoses like dementia, depression, and diabetes; self-reported general health &amp; past falls.</li> <li>• Both studies assessed 6 predictors for 6-month fall risk permitting meta-analysis: past falls, residential status, use of walking aids, <math>\geq 6</math> medications used daily, self-reported dementia, self-reported depression with minimal statistical heterogeneity in pooled estimates of LR accuracy.</li> <li>• No single risk factor accurately predicted 6-month fall risk (Table 2 on page 1074 and Table 3 on page 1075).</li> <li>• The following predictors most accurately <b>increased</b> the risk of 6-month falls: <ul style="list-style-type: none"> <li>Non-healing foot-sore (LR+ 2.54, 95% CI 1.62-3.98)</li> <li>Depression (LR+ 2.54, 95% CI 1.62-3.98)</li> <li>Borderline functional mobility (LR+ 2.52, 95% CI 1.04-6.12)</li> <li>Indoor falls (LR+ 2.16, 95% CI 1.43-3.26).</li> </ul> </li> </ul>

		<ul style="list-style-type: none"> <li>• No predictor accurately <b>decreased</b> the risk of 6-month falls. The lowest LR- was 0.57 (95% CI 0.38-0.86) for ability to cut one's own toenails.</li> <li>• None of the objective functional tests (chair stand, tandem gait walk, etc.) significantly increased or decreased the probability of falls at 6-months, but one study demonstrated that objective assessment of these mobility assessments are reliable with an intraclass correlation coefficient of 0.77 (95% CI 0.66-0.87).</li> </ul> <p><b>Fall Risk Screening Instruments</b></p> <ul style="list-style-type: none"> <li>• Three studies of 767 patients evaluated fall-risk: Tiedemann, Carpenter, and CAGE (see below for more details).</li> <li>• The best instrument to identify patients at <b>increased risk</b> is Tiedemann &gt;2 (LR+ 3.76, 95% CI 2.45-5.78) and the best instrument to identify patients at <b>lower risk</b> for fall is Carpenter Score of 0 or 1 (LR- 0.11, 95% CI 0.06-0.20). (p. 1075) Unfortunately, 39% of the patients in Carpenter's study did not complete the full 6-month follow-up and Tiedemann et al. do not report how many patients completed 6-months of follow-up (see PGY-I and PGY-II Answer Keys).</li> <li>• Previous systematic reviews that excluded ED-based fall risk assessment studies and which did not report likelihood ratios advocated use of <a href="#">Hendrick II</a> (7-question survey + get-up-and-go functional test) or <a href="#">STRATIFY</a> (5-question instrument). The current systematic review authors calculated likelihood ratios for these two instruments to compare with Tiedemann &amp; Carpenter's tools, noting that neither is superior to Tiedemann or Carpenter: Hendrick II (LR+1.8, LR- 0.33) or STRATIFY (LR+ 1.1, LR- 0.81). (p. 1078)</li> <li>• The modified CAGE to assess past falls did not increase (LR+ 1.73, 95% CI 1.07-2.81) or decrease (LR- 0.69, 95% CI 0.47-1.01) fall risk.</li> </ul> <p><b>Test-Treatment Threshold</b></p> <ul style="list-style-type: none"> <li>• Based upon the sensitivity/specificity (93% and 61%, respectively) of the Carpenter instrument at threshold &gt;1, benefit of fall-risk intervention derived from the <a href="#">PROFET study</a> (20% absolute risk reduction, see PGY-IV Answer Key), and</li> </ul>
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		<p>hypothesized risk of test of 0.5% and risk of intervention in patient without disease 2%, the test threshold was estimated at 7% and the treatment threshold at 27%.</p> <ul style="list-style-type: none"> <li>The authors provide an Excel calculator available online for readers interested in recalculating the Test-Treatment threshold based upon different assumptions for these 7 variables.</li> </ul>
2.	How precise are the results?	See 95% CI's above.
3.	Were the results similar from study to study?	<p>Yes. "Meta-analysis of the six risk factors assessed by Tiedemann et al. and Carpenter et al. revealed minimal statistical heterogeneity in pooled estimates of accuracy for LRs, although pooled estimates of accuracy for sensitivity and specificity were more heterogeneous." (p. 1073).</p> <p>Also, "Despite the differences in patient population, both studies' 6-month fall risk factor accuracy estimates are quite similar." (p. 1073)</p>
<b>III.</b>	<b><i>Will the results help me in caring for my patients?</i></b>	
1.	How can I best interpret the results to apply them to the care of my patients?	<p>Although the results fail to provide a definitive fall screening strategy, the quantitative summary estimates of fall incidence and risk factor accuracy and reliability provide an evidence basis on which clinicians, nursing leaders, administrators, educators, policy-makers, and researchers can build. Fall prevention (both risk stratification and interventions) in ED settings has been disappointing and largely unsuccessful. No single risk factor significantly increases or decreases the risk of 6-month falls for geriatric ED patients. In one single-center study, one instrument identified low-risk patients (LR- 0.11), but additional research is needed to reproduce these results and no instrument accurately identifies high-risk patients.</p>
2.	Were all patient important outcomes considered?	No, injurious falls, fear of falling, and the psychological consequences of falls are patient-centric outcomes that were not consistently assessed or reported.
3.	Are the benefits worth the costs and potential risks?	<p>No, the current data do not support routine fall-risk screening in contrast to recently published <a href="#">AGS/BGS Fall Guidelines</a>, <a href="#">ACEP/SAEM Geriatric ED Guidelines</a>, and <a href="#">EM resident core competencies</a>. Nonetheless, research is desperately needed to develop protocols by which to do so. "...a more accurate fall risk stratification instrument could provide feasible, targeted prevention interventions focused on the unique risk inherent to</p>



	individual patient(s).” (p. 1078)
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4.	How will you communicate the findings of this study with your patients to facilitate shared decision-making?	Identifying which community-dwelling elderly patients will fall in the 6-months after an ED visit remains challenging. Emergency medicine currently lacks sufficient high-quality evidence to recommend any fall screening protocol with sufficient accuracy and reliability to distinguish those at increased or decreased risk of 6-month falls. However, inaction is not a viable option so this is what we do understand with limited confidence. (1) Past falls predict future falls, as evidenced by a 6-month incidence of 31% for falls among geriatric patients in the ED for a fall versus 14% in similarly aged non-fallers in the ED. (2) One risk-stratification instrument might predict subsets of patients at decreased risk for falls by reducing the 31% risk to 4.7% -- but this is very preliminary and requires much more research to confirm.
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### Limitations

- 1) None of the original studies used the [STARD criteria](#), increasing risk of biased conduct and reporting of these prognostic studies.
- 2) None of the studies used objective measures for confounding geriatric syndromes like [dementia](#), [delirium](#), [frailty](#), or [depression](#), limiting confidence in the reliability and internal validity of these predictors.
- 3) The definition of falls varied across studies. Future ED-based (and other) geriatric falls researchers should develop upon one agreed upon definition for falls.
- 4) The primary outcome of falls was self-reported, likely [underestimating](#) fall incidence due to occult cognitive dysfunction and health literacy.
- 5) Multiple fall-risk instruments have never been assessed in ED settings, including [ABCS](#), [CAREFALL](#), [FROP-COM](#), [HOME FAST](#), [Hendrich II](#), [STRATIFY](#), [University of Pittsburgh](#), [New York-Presbyterian](#), [Johns Hopkins](#), [Maine Medical Center](#), [Morse Fall Scale](#), and the [Spartanburg Fall Risk Assessment Tool](#).



- 6) **The results are limited to community-dwelling geriatric adults and English-language research reports.**

### **Bottom Line**

**Although the results fail to provide a definitive fall screening strategy, the quantitative summary estimates of fall incidence and risk factor accuracy and reliability provide an evidence basis on which clinicians, nursing leaders, administrators, educators, policy-makers, and researchers can build. Fall prevention (both risk stratification and interventions) in ED settings has been disappointing and largely unsuccessful. No single risk factor significantly increases or decreases the risk of 6-month falls for geriatric ED patients. In one single-center study, the “Carpenter instrument” identified low-risk patients (LR-0.11), but additional research is needed to reproduce these results and no instrument accurately identifies high-risk patients. The ideal fall risk screening instrument would be accurate and reliable, sufficiently brief for routine ED use by clinicians, nurses, or ancillary staff, and not require equipment that is not routinely available in the average ED.**

### **Risk Stratification Instruments for 6-Month Fall Risk in Community-Dwelling Older Adults in the Emergency Department**

#### **Carpenter**

1. Presence of non-healing foot sore?
2. Any fall in last 12-months?
3. Inability to cut own toenails?
4. Self-reported depression?

Interpretation > 1 “yes” responses is a community dwelling older adult at increased risk for falls.

#### **Modified CAGE**

1. Have you ever felt that you should do something to prevent the possibility of your falling?
2. Does it annoy you that your friends or family worry about your falling?
3. Have you felt ashamed or guilty about falling?
4. Have you ever denied to others that you have fallen?

5. Do you ever worry that others will treat you differently if they know you have suffered a fall?

Any “yes” response is scored “1” versus “no” response scored 0. Interpretation  $\geq 1$  “yes” responses = older adult at increased risk for falls.

### **Tiedemann**

1. Two or more falls in the past year? (2 points)
2. Take 6 or more medications? (1 point)

Interpretation Score  $> 2$  = older adult at increased risk for falls.