

## An Emergency Department Screen to Identify Older Adults at-Risk for Falls

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### Abstract

**Background:** The purpose of the study was to develop a preliminary Fall Risk Screening tool and determine the ability of the instrument to identify older adults with fall risk factors and those at-risk for future falls and fear of falling in the Emergency Department (ED).

**Methods:** The ED Fall Risk Screen was initially tested on 42 community-dwelling older adults in the ED who completed the screen and follow-up phases. The tool was subsequently revised by adding select physical performance tests and administered to a second cohort of 103 older adults on-site in the community. Three month follow-up was performed. Statistical analyses included logistic regression modeling for prediction of both falls and fear of falling.

**Results:** Fifteen of the ED patients (35.7%) had two major fall risk factors, including: previous falls, decreased leg strength, and balance and gait problems. On follow-up, three falls occurred in two people and 15.7% reported fear of falling. Of the 103 community living subjects (age: 79.3 ± 10.4 years) completing the 3-month follow-up, 76.7% had one or more major fall risk factors, 21 subjects had fallen, and 19% reported a fear of falling. Timed Up and Go Test performance slower than 12 seconds was an independent predictor of both falls and fear of falling among the community-living group ( $p < 0.05$ ). Select questions and objective balance and mobility tests predicted future falls by 70%, and fear of falling by 71%.

**Conclusions:** Older adults are discharged from the ED with known fall risk factors. Pilot testing of the Fall Risk Screen demonstrated psychometric capability to predict falls and fear of falling among community living older adults. A final version of the instrument will be tested in the ED to determine its sensitivity and specificity to predict both conditions in this setting. Older adults with fall risk factors should receive follow-up prevention strategies.

**Keywords:** Emergency department; Fall risk screen; Fear of falling

**Abbreviations:** ABC: Activities-Specific Balance Confidence; ED: Emergency Department; FOF: Fear of Falling; GSR: Gait Stability Ratio; SLS: Single Limb Stance; ST: Semi Tandem; TS: Tandem Stance; MDRT: Multi-Directional Reach Test; TUG: Timed Up and Go

### Introduction

Unintentional falls in the home environment are the leading cause of nonfatal injury and fifth leading cause of death in older adults [1,2]. More than one third of the community dwelling older adult population fall each year and only a fifth of these individuals will seek medical assistance for their injuries [3]. In 2009, emergency departments treated 2.2 million nonfatal fall injuries among elder adults; moreover, over half of these patients were hospitalized [4]. For every 100 fallers presenting to the ED: 76 are treated for their injuries and discharged; 23 persons are hospitalized; and one dies. For those discharged home, unintentional injury such as falls in the home poses a major health concern and often goes undetected by community physicians [5,6]. Negative health outcomes of accidental falls are associated with enormous health care costs and declines in physical function, increased fear of falling, increased risk of chronic conditions, and early admissions to nursing home [6-8]. This socioeconomic and medical burden of fall-related episodes in emergency departments is present internationally [9,10].

The overall number of ED visits has increased over the last decade, with persons aged 75 years and older representing the second highest per capita ED visit rate (60.2 visits per 100 persons) in the United States [11]. In 2003, approximately 18% of the ED visits were by patients 65 years or older, and that number is expected to rise to 23% by 2025. While older patients typically have more severe underlying disease and

require admission to the hospital, the majority are still discharged back to home after ED evaluation. Upon discharge, elderly ED patients often decompensate and require additional social, rehabilitative and nursing services. Forty percent of these older patients report functional decline within one week of an ED visit, and 15% return to the ED within four weeks of their initial visit [12-14]. Functional decline, including impairments in strength and balance, are likely to increase the risk of falls in these patients. These older individuals represent a high risk target population that would benefit from a safety assessment as well as injury prevention strategies.

Limited research has documented the characteristics and outcomes of elderly discharged home following a fall [12,15-17]. We recognize a gap in medical care associated with identifying older adults with fall risk factors who return home following an ED visit for problems other than a fall. This raises the theoretical possibility that if the general population of community-dwelling older adults visiting the ED regardless of their reason is screened for fall risk, they can be educated on strategies to reduce fall risk factors and referred for immediate assessment. Such a

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strategy is crucial in helping older adults, their families, and caregivers effectively prevent falls. Additionally, this strategy may reduce the health care costs associated with falls and maintain older adults in their communities.

The first step to develop effective fall prevention strategies is to identify all older ED patients at risk for falls and fear of falling. Currently, the majority of patients seeking treatment in the ED for a fall are not asked about prior fall history [16]. Although the ED recognizes the need to provide screening and preventative programs to promote health in older adults [18], many EDs acknowledge they do not have time to provide a comprehensive assessment in a busy ED environment [12]. A solution is to develop a fall risk screen that is brief, psychometrically salient, and easily administered in this setting.

Our premise is that all older adults, regardless of their reasons for visiting the ED, may possess fall risk factors associated with balance and functional mobility. We chose to focus on those modifiable risk factors with high relative risk ratios for falls that were associated with both functional mobility and fear of falling. Mobility is a major requisite for independent living because impaired mobility dysfunction and associated fear of falling can lead to a decreased quality of life and truncate independent living. The purpose of the current longitudinal study was to develop a brief fall risk screen for use in emergency departments and to obtain evidence concerning its capability to identify individuals at risk for falls and those with a fear of falling. Specifically, the objectives were to: 1) Determine the proportion of ED patients found to have major fall risk criteria and identify those who have a fear of falling after discharge from the ED to an urban community; and 2) Determine if the revised Fall Risk Screen containing select balance, mobility and fear of falling measures predict both falls and fear of falling in community-dwelling older adults. The community group was chosen because they are representative of individuals who might visit an ED and to pilot administration of physical performance tests in a more feasible community setting than the hectic ED. Once the tests are identified to predict fear of falling and future falls, the final revised brief screen can be validated in the ED.

## Materials and Methods

### Study sample

A total of 174 subjects were enrolled into the study. Fifty-one patients aged 60 years and older (mean age=70.2 ± 7.6 yrs) were asked to participate in the study while they were in an ED and prior to their discharge. They had a variety of complaints other than a fall that are typically seen in the ED. The sample of convenience was recruited during an eight week period. Inclusion criteria included community dwelling adults over the age of 60 years who were evaluated and treated in the ED and discharged back home, and had satisfactory communication and cognitive skills in English to answer the questions. We excluded patients with cognitive impairment as defined by a six-point cognition screen [19], and those with confounding medical conditions that would render them more sedentary after discharge from the ED, e.g., severe weightbearing pain or used a wheelchair as a primary mode of transportation. Patients with a terminal medical condition were also excluded.

A non-patient group consisted of 123 community dwelling participants who lived in private residence or senior housing facilities. This convenience sample was recruited during a 12 week period from the urban Philadelphia area through communication with facility center coordinators. The sample included older adults who might potentially visit an emergency department for various medical

conditions, including Parkinson's disease, diabetes, arthritis, and other conditions associated with fall risk. Inclusion criteria mandated that subjects be over the age of 60 and independent in ambulation with or without an assistive device. The cognition and mobility exclusion criteria used for the ED patients were similarly applied to this group. All participants gave written informed consent that was approved by the Institution's Internal Review Board.

### Procedures

Each question in the ED Fall Risk Screen (Table 2) was read to the ED patient and answers were recorded directly on the form. Questions on the screen were related to pertinent functional mobility deficits, fall history, and medical conditions. The Six-Item Screener for Cognitive Impairment was also administered [19,20].

Using the cut-off score of <4, the Six-Item Screener has a sensitivity of 89% and specificity of 88% to identify cognitive impairment, comparable to the sensitivity and specificity of the Mini-Mental State Examination (95 and 87%, respectively). Patients scoring below the cut-off score were excluded from the study.

All subjects in the community group were tested at their respective sites. They received the revised ED Fall Risk Screen consisting of questions (Table 2), the Six-Item Screener for Cognitive Impairment, and select balance, mobility and fear of falling measures. The following physical performance tests were administered:

- Tandem Stance (TS) and Single Limb Stance (SLS) measures the time the person performs each stance (maximum of 30 seconds) [21].
- The Multi-Directional Reach Test (MDRT) measures limits of stability in four directions by having the person perform maximal reaches with the outstretched arm forward, to the right, to the left, and finally backwards [22,23]. A yardstick affixed to a telescoping pole and parallel to the floor was used to measure the reach excursions.
- The Timed Up and Go Test (TUG) measures the time taken for a person to stand up from a chair (46 cm seat height), walk at his/her preferred speed for 3 m, turn, walk back to the chair and sit down [24]. Ninety-two percent of community-dwelling older women should be able to perform the TUG in less than 12 seconds [25].
- The 20-foot Walk Test consists of a 40 foot straight and level pathway. The initial ten feet and last ten feet are used for acceleration and deceleration phases. The number of foot-falls and the time to walk the middle 20 feet were recorded to obtain velocity and the Gait Stability Ratio (GSR). The GSR is derived from the velocity and cadence measures [ $GSR = \frac{\text{steps}}{\text{meter}} = \text{cadence} \div \text{velocity}$ ] and is a measure of dynamic balance and assesses the degree of stability of the gait pattern [26].
- Fear of Falling and Activity-Specific Balance Confidence Scale (ABC). Subjects were asked for the one question fear of falling (yes/no response) and if a fear of falling decreased their activity. The ABC is a self-rating of the person's confidence to perform 16 activities without losing balance [27]. A lower average score is indicative of a fear of losing balance and falling.

### Outcome measures and follow-up

The number of falls and fear of falling were the outcome measures reported at follow up. The ED patients were called approximately six

weeks following their visit to the ED and asked several questions. First they were asked if they had fallen since discharge from the ED. Subjects were also asked if they had a fear of falling and, if so, did they decrease their activity because of this fear.

Based on the results of the ED patients, e.g. only three falls were reported in two patients, we increased the time of the follow-up in the community group from six weeks to three months in order to capture the fall events. The community group received the same follow-up survey as the ED group. Those living in senior living facilities were supervised by the center coordinator as they completed the questionnaires.

### Data analysis

Descriptive statistics were used to examine the characteristics of the sample. A frequency analysis was used to determine the proportion of ED patients and community subjects with major fall risk factors associated with balance and functional mobility. Independent *t*-tests and Fisher's Exact tests were performed to analyze demographic and co-morbidity comparisons between the ED and community groups. Data from the ED Fall Risk Screen and the follow up questionnaire were entered into SPSS v19 (IBM, Chicago, Illinois). Significance was set at 0.05 level.

To identify subjects with an increased risk of falling or fear of falling, logistic regression analyses adjusted for age and gender were performed with falls or fear of falling at the follow-up as the dependent variable. For the ED subjects, the range of independent variables were the eight questions on the ED Fall Risk Screen. For the community group the range of independent variables included the eight questions on the ED Fall Risk Screen and cut scores obtained from the literature for the balance [21-23], TUG [25] and fear of falling measures [28].

## Results

### Emergency department patients

The sample of fifty-one patients presented to the ED of a large urban teaching hospital for a variety of reasons other than a fall. Most (over 80%) patients had at least one chronic or co-morbid condition (Table 1). One patient did not pass the Six-Item Screener for Cognitive Impairment and was excluded from the study.

Forty-two subjects (82.4%) completed the six-week follow-up questionnaire. Those lost to follow-up were unable to be reached, or were not interested in answering the questions. At baseline, nine subjects (21.4%) reported a past history of falling and of those four (44%) were unable to get up unassisted (Table 2). Over 97% of the patients had one or more of the following major fall risk factors: previous falls, decreased strength in the legs, balance and gait problems, and the use of an assistive device. Forty three percent (42.9%) had one major fall risk factor; and over 50% had two or more major fall risk factors (Table 3).

Of the 42 subjects completing the 6-week follow-up, two fell for a total of three falls, which was insufficient for additional analysis. Eight (19%) subjects reported a fear of falling with decreased activity. Multivariate logistic regression analyses demonstrated that a past history of falls ( $p < 0.001$ ); problems with walking and balance ( $p = 0.003$ ); and use of an assistive device ( $p = 0.048$ ) were independent predictors of fear of falling at six weeks. The independent predictors were entered into a logistic regression model (backward entry) and the combination of factors predicted fear of falling at six weeks by 59% (Nagelkerke  $r^2$ ;  $p < 0.001$ ).

### Community group

Of the 123 subjects initially recruited, five were not interested in participating and 11 were excluded based on their scores ( $< 4$ ) on the Six-Item Screener for Cognitive Impairment. Four additional subjects were lost at the three month follow-up secondary to medical status or relocation. The remaining 103 subjects of the community group (mean age =  $79.3 \pm 10.4$  years) reported similar chronic or co-morbid conditions as the ED group (Table 1), though they were significantly older. Arthritis and heart disease were the two most common self-reported conditions in both groups.

Twenty two percent (22%) of the subjects had a prior fall with the majority (91.3%) of the falls occurring indoors (Table 2). Less than half of the subjects were unable to get up independently following a fall. Seventy-seven percent (77%) subjects had one or more of following major fall risk factors: previous falls, decreased strength in the legs, balance and gait problems, and the use of an assistive device (cane). Twenty-three percent of subjects (23%) had one major fall risk factor; 22.3% had two major fall risk factors; 31.1% had three or more major fall risk factors (Table 3).

Subjects demonstrated a mean gait velocity of  $0.85 (\pm 0.3)$  m/sec and  $16.4 (\pm 8.2)$  seconds on the TUG Test. Mean reach excursions on the Multi-Directional Reach Test were 7.4 (forward), 3.7 (backward), 5.4 (right), and 5.3 (left) inches respectively (Table 4). At three month follow-up, 21 falls had occurred since the baseline fall risk assessment. The majority of falls occurred indoors, with falls in the hallway, bathroom and bedroom being the most common locations reported. Nineteen percent reported fear of falling with decreased activity.

The independent predictors were entered into a logistic regression model (backward entry). The following combination of factors predicted falls at three months by 70.1% (Nagelkerke  $r^2$ ;  $p < 0.001$ ): past history of falls and FOF reported at baseline; FR score  $< 9$  in.; summed ST-T score of less than 20 sec (max = 60 sec); TUG score slower than 12 sec.

Those individuals who had a tandem sum score of less than 20 seconds are more likely to have FOF at three months (71.4%;  $p = 0.49$ , Fisher's Exact test). The following measures were independent predictors of FOF ( $p < 0.05$ ) use of an assistive device, a TUG slower than 12 sec; and backward reach score of less than 5 inches.

## Discussion

A brief fall risk screen administered in the ED can identify those older adults with risk factors that are associated with functional mobility (e.g., balance and gait) and the tool can be predictive of those with FOF with decreased activity. The brief screen did not predict

Characteristic	ED group (n = 42)	Community group (n=103)	p
Age, $\bar{X}$ (SD)	71.1 (7.9)	79.3 (10.4)	<.001*
Female, n (%)	21 (50.0)	80 (77.7)	.001*
<b>Co-morbid Conditions</b>			
Arthritis n (%)	27 (64.3)	63 (62.1)	.51
Cardiac conditions, n (%)	23 (54.8)	64 (63.6)	.26
Diabetes, n (%)	13 (31.0)	24 (22.4)	.19
Neurologic (stroke, Parkinson's disease), n%	6 (14.3)	15 (14.6)	.60

\*Significant:  $p < .05$

**Table 1:** Characteristics of Older Adults Discharged Home from ED and the Community Group.

Question on the Fall Risk Screen (Yes,%)	ED group (n=42)	Community group (n=103)
Have you fallen within the last three months?	9 (21.4)	23 (22.3)
If yes, did you fall indoors?	6 (66.7)	21 (91.3)
Were you able to get up after falling?	4 (44.4)	11 (47.8)
Do you have poor strength in your legs?	26 (61.9)	45 (43.7)
Do you usually use a walker or cane?	19 (45.2)	58 (56.3)
Is your vision bad (include prescriptive glasses)?	33 (78.6)	96 (93.2)
Do you have a problem walking or keeping your balance?	19 (45.2)	38 (36.9)
Do you have a problem walking?		39 (37.9)
Do you have a problem keeping your balance?		
Are you dizzy/lightheaded or do you pass out when you stand up?	20 (47.6)	28 (27.2)
Do you take more than four medications?	29 (69)	62 (60.2)
Are you over age 80?*	6 (14.3)	62 (60.2)

**Table 2:** Incidence and Proportion of Fall Risk Factors among the ED and Community Group. Positive Responses to the Questions are Reported.

Characteristic	ED group (n=42)	Community group (n=103)
<b>Major Fall Risk Factors</b>		
1 major risk factor, n (%)	18 (42.9)	24 (23.3)
2 major risk factors, n (%)	15 (35.7)	23 (22.3)
3 or more major risk factors, n (%)	8 (19.1)	32 (31.1)

**Table 3:** Number of Major Fall Risk Factors.

Name of Test	Community Group (X, sd)
Multi-Directional Reach Test (inches)	
Forward	7.4 (3.3)
Backward	3.7 (2.5)
Right	5.4 (2.7)
Left	5.3 (2.6)
Timed Up and Go (sec)	16.4 (8.2)
Stance Tests (30 sec max)	
Eyes Open	29.7 (2.3)
Eyes Closed	27.7 (6.9)
Semi-tandem	23.6 (10.5)
Tandem	12.1 (12.4)
Single leg stance – right	7.1 (15.5)
Single leg stance – left	7.0 (15.6)
20-Foot Walk Test	
Velocity (m/sec)	0.85 (0.3)
Gait Stability Ratio (steps/meter)	2.3 (0.7)
Activity-Specific Balance Confidence Scale (%; 100 Max)	70.5 (23.6)
Fear of Falling (Yes; n, %)	29 (28.2)
Fear with Decrease Activity (Yes; n, %)	20 (19.4)

**Table 4:** Balance, Gait and Fear of Falling scores for the Community Group (n=103).

future falls, with only three falls reported in the six week follow-up. This could be due to the time to capture subsequent falls was too short. Our modified fall risk screen was subsequently revised to include a

three month follow-up period and thereby provide a larger window to track fall events among the community-dwelling older adults.

Although at face value the initial Fall Risk Screen appears to have limited capability to identify those ED patients who subsequently fall, our findings for the initial tool are significant because we were able to target those older adults with FOF and decreased activity levels. A positive response to ‘problem walking or keeping balance’ was an independent predictor of subsequent FOF. Of particular importance, this finding was found in older adults visiting the ED for a variety of complaints other than falls.

Existing studies indicate that older adults leaving the ED have functional declines [12,13,17]. This published outcome coupled with our findings of FOF resulting in a decrease in activity indicate that patients leaving the ED and returning home are becoming more sedentary, decreasing their activity levels, and are increasing their likelihood for a fall. A decrease in activity level is part of a vicious cycle of functional and mobility decline as evidenced by muscle weakness, gait and balance instability, and increased risk of falls [29]. Furthermore, fear of falling with decreased activity may lead to worsening health status such as obesity, cardiovascular disease, thrombotic disease, and osteoporosis.

While the ED screen did not have objective balance and gait tests to substantiate self-reported responses to questions about problems with balance and gait, our approach was begin to identify fall risk. In a retrospective chart review of 300 older adults who presented to the ED secondary to a fall, Miller et al. [30] discerned that fall risk factors were not regularly evaluated or documented. Although our intent was to capture mobility assessment through self-report, patients’ perception of their balance might have been better than how it would have been documented by more objective tests. The initial ED Fall Risk Screen was revised to include select measures of physical performance, e.g., balance and gait, to corroborate self-reported questions, assess physical performance, and to determine if these measures could predict future falls and FOF.

The second phase of our study was to pilot the revised tool in community-dwelling older adults to determine the best predictors for future falls and confirm predictive validity of the instrument. The final version of the brief Fall Risk Screen could then be validated in the busy ED. Based on their ability to predict future falls, the FR, TUG, and tandem tests will be included in the final Fall Risk Screen. These physical performance tests have been recommended in guidelines to assess older adults who are known fallers [6,13,31]. To predict fall risk we used cut scores of a FR excursion less than 9 inches, a summed ST-T score of less than 20 sec (max=60 sec), and a TUG time slower than 12 seconds. These threshold scores for testing can be implemented regardless of location and older adults’ entry into the health care system. These tests, while psychometrically stable, also demonstrate versatile clinical utility given that our community-dwelling subjects were older than the initial ED participants and were tested in a variety of community settings.

Interestingly, the TUG was a predictor of both fear of falling and falls in our community group. A score greater (slower) than 12 seconds was independent of falls. Our cut-off score is in line with normative performance values suggested by Bohannon [32] and Bischoff et al. [25], though lower than the 14 second benchmark by Shumway-Cook et al. [33]. The test is a salient outcomes measure which demonstrates potential usefulness in a variety of settings. Although a twenty-foot walk test was administered in the second prong of our validation study, the length of the walk test precluded its utility in an ED setting where space is limited.

Our findings also indicated that the initial and revised ED Fall Risk Screen was able to predict FOF at six weeks for the ED patients and at three months for the community living group, respectively. This finding is further substantiated by the work of Friedman et al. who demonstrated that a history of falls was an independent predictor for developing fear of falling, and conversely those with a fear of falling are at risk for future falls [34]. Similarly, subjects' disclosure of gait and balance problems are in accordance with Hadjistavropoulos et al. [35], who suggest that the association between falls and fear of falling is mediated by compromised balance and gait performance. For patients in the ED, the initial screen was able to predict fear of falling with decreased activity. While we also included the ABC instrument to quantitatively assess balance confidence in the second phase of our validation process to gauge self-efficacy in a variety of challenging situations, the length of the assessment may preclude its use in a brief Fall Risk Screen. The instrument is beneficial for more detailed assessment for those individuals referred to rehabilitation services.

A potential limitation of the study is the ability of the final version of the Fall Risk Screen to be used with patients who have mobility dysfunction or acute conditions that may prohibit them from performing the objective measures. However, both the initial and revised Fall Risk Screens contain a series of questions related to the major fall risk factors associated with functional mobility. These questions identified those ED patients and community group who had multiple fall risk factors associated with mobility dysfunction. Therefore, our current findings support the premise that all older adults entering the ED should receive a screen to identify those with fall risk issues, particularly associated with mobility dysfunction [30]. Those exhibiting multiple risk factors or who demonstrate test scores below the recommended cut scores should be referred for formal balance and gait testing.

Both the preliminary and revised instrument assessed polypharmacy as a potential risk factor. We chose to target the use of four or more medications in conjunction with previous reports of predictive fall risk [36]. Additional focused questions will be added to the final instrument regarding psychoactive medications since antidepressants, antipsychotics, hypnotics, and benzodiazepines have been highly implicated with falls [37].

The preliminary ED Fall Risk Screen appears promising to identify those who have mobility risk factors associated with falls (e.g., gait and balance instability) and who may develop a FOF. The screen is simple and can be administered quickly. The final version of the Fall Risk screen will be validated in the ED and includes measures of balance and gait that can be easily administered in the busy ED setting. Tests such as the TUG, tandem stance, and Multi-Directional Reach require minimal space. These performance-based measures of balance and gait will be used in parallel with the self-reported measures and will be assessed in a larger cohort of older adults in the ED to determine the Screen's sensitivity and specificity. Additionally, we will follow subjects for six months, a more appropriate length of time to assess fall rate. This follow-up window will capture a more accurate fall rate of older ED patients returning to the community as well as both their fear of falling and decreased activity levels.

In summary, our findings suggest that patients discharged home after evaluation and treatment in an urban ED regardless of their initial complaint commonly have risk factors for both falling and FOF, and should be channeled to appropriate resources. Therefore, administering the brief Fall Risk Screen, with referral to rehabilitation services when appropriate, is warranted for older adults discharged from the ED.

The study also demonstrates how the ED can support current fall prevention guidelines and national fall prevention initiatives [38-40].

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All authors contributed to the study design, methods, and data interpretation. Roberta A Newton served as Principal Investigator and oversaw the study implementation. Dennis Kilma was responsible for data collection and analysis. Tina Brown Reid provided support for data interpretation. Nina Gentile oversaw the data collection phase in the Emergency Department component of the study.

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