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Fall Risk Assessment Measures: An Analytic Review

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Background. Clinicians are often unaware of the many existing scales for identifying fall risk and are uncertain about how to select an appropriate one. Our purpose was to summarize existing fall risk assessment scales to enable more informed choices regarding their use.

Methods. After a systematic literature search, 21 articles published from 1984 through 2000 describing 20 fall risk assessments were reviewed independently for content and validation by a panel of five reviewers using a standardized review form. Fourteen were institution-focused nursing assessment scales, and six were functional assessment scales.

Results. The majority of the scales were developed for elderly populations, mainly in hospital or nursing home settings. The patient characteristics assessed were quite similar across the nursing assessment forms. The time to complete the form varied from less than 1 minute to 80 minutes. For those scales with reported diagnostic accuracy, sensitivity varied from 43% to 100% (median = 80%), and specificity varied from 38% to 96% (median = 75%). Several scales with superior diagnostic characteristics were identified.

Conclusions. A substantial number of fall risk assessment tools are readily available and assess similar patient characteristics. Although their diagnostic accuracy and overall usefulness showed wide variability, there are several scales that can be used with confidence as part of an effective falls prevention program. Consequently, there should be little need for facilities to develop their own scales. To continue to develop fall risk assessments unique to individual facilities may be counterproductive because scores will not be comparable across facilities.

FALLS have devastating consequences for older adults in terms of morbidity, mortality, and loss of independence (1). In community-dwelling elderly persons, a history of falls, especially recurrent or injurious falls, increases the risk of admission to a skilled-nursing facility (2), and up to 40% of nursing home admissions are precipitated by falling or instability (3). Within hospitals and nursing homes, falls constitute the single largest category of adverse incident reports (4). One half of nursing home residents (1) and about one third of community-dwelling individuals over age 65 fall each year (5). Approximately 5% of all falls result in fracture, and an additional 5% to 11% result in other serious injuries. Injury due to falls is the leading cause of death in older adults (6). The acute-care cost of treating injurious falls has been estimated in the billions of dollars (7).

Falls have additional effects on the psychological well-being of older adults. The prevalence of postfall anxiety syndrome and function-impairing fear of falling reaches upwards of 73% in recent fallers (8). Even in individuals who report no incidence of recent fall, the prevalence of postfall anxiety syndrome and function-impairing fear of falling is approximately 46% (8). The damaging consequences of this fear on function and independence contribute to further increase in risk of falls (3), can negate gains made through rehabilitation (9), and can result in further costs due to nursing home placement or additional, often prolonged, rehabilitation.

Fall Risk Factors

Much work has been done to identify risk factors for falls; these fall risk factors are generally categorized into intrinsic and extrinsic factors. Intrinsic, or patient-related, risk factors include advanced age, chronic diseases, muscle weakness, gait disorders, mental status alternations, and medications, and these factors can have additive effects (10,11). Rawsky (3) reviewed over 100 articles published from 1979 through 1996 related to falls in the elderly population in a variety of settings (e.g., inpatient hospital, community, psychiatry facility, rehabilitation center, and long-term care facility). The following intrinsic factors were identified most often in the 21 selected studies within Rawsky's review: cognitive impairment/psychological status (16 studies), acute/chronic illness and mobility (14 studies),

sensory deficits (7 studies), fall history (6 studies), and elimination (6 studies). Rawsky's review, however, did not assess the relative risk or odds ratios of these risk factors.

Rubenstein and Josephson (12,13) analyzed the 16 studies that quantitatively reported the relative risk (RR) or odds ratios for multiple risk factors. Their analysis summarized the mean RR associated with the risk factors and reported the following in decreasing magnitude of RR: muscle weakness (RR = 4.4), history of falls (RR = 3.0), gait deficits (RR = 2.9), balance deficits (RR = 2.9), use of assistive devices (RR = 2.6), visual deficits (RR = 2.5), arthritis (RR = 2.4), impaired activities of daily living (RR = 2.3), depression (RR = 2.2), cognitive impairments (RR = 1.8), and age >80 years (RR = 1.7).

Robbins and colleagues (10), using a fall prediction model, demonstrated the predicted 1-year risk of falling to range from 12% in long-term care residents having none of the three most strongly associated risk factors to 100% for long-term care residents having all three risk factors. Tinetti (14), in a prospective study of community-dwelling elderly persons, showed the risk of falling to range from 0% with 0 to 3 risk factors, to 31% with 4 to 6 risk factors, to 100% with ≥7 risk factors. Mahoney and colleagues (15) identified the following factors upon discharge from the hospital as factors for falls posthospitalization: decline in mobility, use of assistive device, cognitive impairment, and self-report of confusion. In general, factors related to cognitive impairment, functional decline, and chronic disorders result in the greater risk of falls.

Extrinsic factors (e.g., environmental hazards or hazardous activities; 10) are described as primary causes for approximately half of all falls (11). In a review of 20 articles, Connell (16) found that environmental hazards (e.g., walking on slippery/rough surfaces, obstacles, inadequate light, or loose carpets) create conditions likely to cause trips or slips in any age group but pose a particular risk for community-dwelling elderly persons who may already have multiple intrinsic risk factors for falls. Additionally, the risk from hazardous activities can be aggravated by behavioral risk factors (e.g., faller was hurried or inattentive, difficulty or discomfort during a task, or moving beyond limits of stability; 16). Within inpatient facilities, commonly reported extrinsic factors are related use of bedrails, height and stability of seating (e.g., low toilets, wheelchair braking problems, "gerichairs," or portable commodes), and obstacles created by mobility aids (e.g., wheelchairs and walkers; 16). Additionally, common locations for inpatient falls are resident rooms or bathrooms, with the falls often involving problems with ambulation and transfers (16).

Fall Risk Assessment

Because of the extreme cost both to the patient and to society, much work has been done to develop preventive programs throughout the continuum of care. Although there are many interventions proposed for fall prevention depending on the patient population, the initial step for virtually all of these programs is the fall risk assessment, which is performed to identify persons at highest risk upon whom to target specific interventions. Fall risk assessment, however, is not standardized within or across settings. Traditionally, three types of assessments relevant to falls and mobility have been done, usually on the basis of setting or specific discipline factors. These include (i) comprehensive medical assessments performed by geriatricians or nurse practitioners in the outpatient or nursing home setting, (ii) nursing fall risk assessments completed in hospital and nursing home settings, and (iii) functional mobility assessments completed by physical therapists or physicians in an outpatient setting.

The first approach (comprehensive assessment) is generally used by geriatricians and nurse practitioners to evaluate and treat patients at risk for falls or who have recently fallen (17). The assessment can be part of an overall geriatric assessment or specific to risk factors for falling as part of the postfall assessment. This type of assessment entails in-depth medical evaluation of previous falls, cognition, balance, gait, strength, chronic diseases, mobility, nutrition, and medications (18). Such assessment is time consuming (19) and often involves a team of clinicians (20). Although this assessment focuses on identifying intrinsic risk factors that can be treated to reduce the likelihood of a fall (17), it does not provide a fall risk index per se and will not be addressed further in this analysis.

The nursing assessment of a patient's risk of falling has been widely performed in hospital and nursing home settings for several decades and typically employs specific screening instruments or forms. These instruments [e.g., Morse Fall Scale (21), STRATIFY (22), Resident Assessment Instrument (RAI; 23), Fall Risk Assessment Tool (24), Hendrich Fall Risk Model (25), High Risk for Falls Assessment Form (26), or Royal Melbourne Hospital Risk Assessment Tool (27)] identify who is likely to fall on the basis of intrinsic or medical characteristics of the patient (e.g., psychological status, mobility dysfunction, fall history, elimination frequency/dependence, acute/chronic illnesses, and sensory deficits). These instruments are most widely used by nurses upon admission to a hospital or long-term care facility and are periodically updated (e.g., per shift, daily, or weekly) depending on the acuity level of the patients. Because of the frequency of use, these tools tend to be short and do not require intensive assessment of the patient. Poor scores tend to trigger either further assessment or anticipatory nursing interventions (e.g., staff routinely provides assistance with toileting or out of bed activities; 3).

Risk assessment of community-dwelling, elderly individuals based on functional assessment instruments has also become common. These instruments focus on functional limitations in gait and balance [e.g., Tinetti Performance Oriented Mobility Assessment (28), Berg Balance Test (29), Functional Reach (30), or Dynamic Gait Index (31)] and have been reviewed by Berg and Norman (32). Only some have specifically tested the ability to predict falls, but all provide standardized measures of disability and functional limitations. Typically, these measures do not assess intrinsic factors related to falls other than gait and balance. These functional assessment tools are most widely performed by physical therapists for outpatient, community-dwelling patients regardless of medical diagnosis. Additionally, some are used by geriatricians as part of a comprehensive geriatric assessment. Some of these tools are quite detailed and can be

burdensome to the patient, requiring the patient to walk, get up from a chair, and/or perform other functional activities, and time consuming for the practitioner, taking up to 20 minutes to complete. In clinical settings, poor scores typically trigger functional interventions (e.g., muscle strengthening, gait/balance training, or aerobic exercise) (33).

Despite the many fall risk assessment tools available in the literature, assessing both intrinsic risk factors and functional limitations, there often is a lack of awareness of existing scales among clinicians and uncertainty regarding how to select a scale appropriate to their patient population. Quite often an individual hospital or long-term care facility will develop its own fall risk assessment scale on the basis of intrinsic risk factors from the literature or retrospective chart reviews of their own patient falls. These instruments, however, often lack psychometric standardization such as reliability or validity determination. The objective of this paper is to summarize information regarding existing nursing and functional fall assessment scales so that clinicians can make more informed choices. Medical assessment was not a focus of this review because this approach does not usually involve the use of specific scales.

Methods

Information was obtained through a comprehensive search of the English language medical literature to identify articles that described new scales or evaluated existing scales. Medline (1966 to January 2001), CINAHL (1982–2001), and HealthSTAR (1975–1999) were searched. The specific search terms were the same for the three databases and included accidental falls, falls, experimental risk assessment, experimental risk management, geriatric assessment, experimental questionnaires, and risk assessment. The search yielded 21 articles published from 1984 through 2001 that described 20 fall risk assessment scales. These were reviewed independently by a panel of five reviewers; each article was reviewed independently by two reviewers, and each reviewer reviewed approximately eight articles. All reviews were done using a standardized review form (Table 1). There was a high interrater reliability between reviewers, and all differences were discussed until consensus was achieved.

Table 1. Standardized Review Form

Parameter Number	Variable
1	Name of scale
2	Developer(s)
3	Sample size
4	Primary intended use—setting: (inpatient, outpatient, long-term care)
5	Presentation of actual form
6	Objective of use (e.g., classifying level of risk for fall prevention protocol, further assessment, or other [describe])
7	Number of items
8	Number of subscales
9	Recommended frequency of use
10	Recommended training for users—Yes-No. If yes, describe
11	How items selected: • Empirically (by determining items which best predict who will fall) • Taken or adapted from other scales • Developers' intuitions
12	Format of questions: • Yes-No • Multiple choice • Likert scale • Other
13	Responses to items based on clinician subjective assessment or more "objective" process (if latter, describe)
14	Time required to administer or complete
15	Burden on patient—Yes-No. If Yes, describe any special testing or observation of patient that requires patient's involvement
16	Items linked to specific interventions — Yes-No. If Yes, describe
17	Cut-off point(s) for level of risk presented or suggested — Yes-No. If Yes, describe cut-off points and how selected by developers
18	Validity testing — Yes-No. If Yes, describe
19	Reliability testing — Yes-No. If Yes, describe
20	If items selected empirically (see #9), how well did instrument predict who would fall? Describe findings.

Results

The findings from the literature review are summarized in Table 2. The articles described 14 nursing assessment tools and six functional assessment scales. The majority (all six of the functional assessments and 8 of the 14 nursing assessments) of the articles were developed on older populations (over the age of 60). All of the nursing assessments were developed within the hospital or nursing home setting, as were two of the functional assessments (28,34). Sample size varied widely (from 26 to 1217 subjects assessed per study), but the median sample size for the functional assessment scales (79 subjects) was less than half of the median sample size for the nursing assessments (161 subjects). All form developers used empirically derived patient characteristics based on previous literature or data obtained retrospectively from incident reports or patient medical records intended to illuminate key characteristics of fallers. Some form developers employed a two-stage development validation process with a small pilot sample using patient characteristics obtained from incident reports or medical records to derive the scale followed by a larger prospective confirmation study of the reliability and validity of these characteristics in a separate population (21–24,35,36).

Most scales (three of the six functional assessments and 11 of the 14 nursing assessments) employ a yes/no item response format in all or part of the form. Multiple choice is employed in two functional assessment scales (29,31) and 3 of the 14 nursing assessment scales (27,35,36). A combination of objective and subjective questions is used in all but two functional assessment instruments [subjective only (34); objective only (37)] and one nursing assessment instrument (25). The length of the forms varies considerably, from 4 to 23 questions (a median of seven questions for either type of assessment tool). All but two (23,38) articles illustrate the actual tool used, whereas the other two provide detailed description.

The patient characteristics assessed are quite similar across nursing assessment forms (Table 3). The following intrinsic risk factors appear most often in the 14 nursing assessment tools within this review (Table 3): mental status (13 tools), mobility (10 tools), history of previous fall (10 tools), secondary or specific diagnoses (8 tools), incontinence or toileting issues (8 tools), medications (7 tools), and sensory deficits (e.g., vision, hearing, sensation) (7 tools). Nine of the 14

Table 2. List of Articles Reviewed

Review Parameter	2	4	3	7	9	14	10	19	17	20	20
Tool	Author	Intended Setting	Sample Size	Number of Items	Frequency of Use	Time	Training	Interrater Reliability	Cut-Off	Sensitivity	Specificity
Functional Assessment Tools											
Berg Balance Test	Berg (29)	OP, CVA		14	Initial	15 min	y	95%	49	77	86
Elderly Fall Screening Test	Cwikel (34)	OP, NH	361	6		17 min	y	n	3	93	78
Dynamic Gait Index	Whitney (31)	OP-vestib	133	8	Initial and reeval	15 min	n	n	19	85	38
Timed Up & Go	Shumway-Cook (37)	OP	30	1	Initial	<1 min	y	0.98	14	87	87
Tinetti Performance Oriented Mobility	Tinetti (28)	IP, OP	79	9	Initial	20 min	y	90%	10	80	74
Modified Gait Abnormality Rating scale	VanSwearingen (43)	OP	52	7	Initial	3 min	y	0.58–0.60			
Nursing Assessment Tools											
Reassessment Is Safe Kare	Brians (39)	IP, NH	208	4	Admit		n	n	1		
Fife	Fife (26)	IP		7	Admit		n	n			
Hendrich Fall Risk Model	Hendrich (25)	IP	338	7	Admit	<1 min	n	97.5%	3*	77	72
Fall Risk Assessment Tool	MacAvoy (24)	IP	89	8	Admit		n	0.90	10*	43	70
Morse Fall scale	Morse (21)	IP	100	6	Daily	<1 min	y	0.96	45*	78	83
Morse Fall scale	McCollum (42)	IP	458	6	Daily	<1 min	y	83–100%	55*	83	68
Royal Melbourne Hospital Risk Assessment Tool	Mercer (27)	IP		9				n	4, 14*		
Resident Assessment Instrument	Morris (23)	NH	187	99	Admit	80 min	y	0.79			
Fall Prediction Index	Nyberg (44)	IP-CVA	135	8	Admit			n	5	100	44
STRATIFY	Oliver (22)	IP	1217	9	Admit, wkly		n	n	2	93	88
Patient Fall Questionnaire	Rainville (36)	IP	26	5	Admit, wkly		y	n	7*		
Fall Assessment Questionnaire	Rapport (40)	IP-CVA	32	10	Admit		n	n	3	73	88
Fall Risk Assessment Tool	Schmid (35)	IP	334	5	Admit, wkly		n	83–99%	3*	93	78
Assessment for High Risk to Fall	Spellbring (38)	IP	30	13	Admit	17 min	y	90%	n		
High Risk for Falls Assessment	Young (41)	NH		7	Admit, yrly		y	n	n		

Note: OP = outpatient; CVA = cerebrovascular accident; NH = nursing home; vestib = vestibular patients; IP = inpatient.
*Cut-off threshold score linked to interventions.

nursing assessments (21,22,25,27,35,38–41) contain the following three broadly defined factors in common: functional decline (mobility and/or balance limitations, use of assistive devices, or activities of daily living deficits), cognitive impairment, and previous history of falls. These parameters (functional decline, cognitive impairment, and previous history of falls) are also within the five most commonly cited risk factors for falls observed in the Rawsky (3) review, demonstrating the strong similarity of the tools to risk factors identified in the research literature, as well as to each other.

The time to complete the form was reported for 11 instruments and varied widely, from less than 1 minute to 80 minutes (the latter being the time for the entire RAI). The median time to complete the functional assessment tools was much longer (15 minutes) than to complete the nursing assessment tools (1 minute), although only five of the nursing assessments reported the actual time. The burden to the patient was not reported for any of the instruments. Procedures for using the form were not explicitly outlined in 6 of the 14 nursing assessment tools but were explicitly outlined in all but one of the six functional assessment tools. Data on interrater reliability was provided for seven nursing and four functional assessment tools. Interrater reliability ranged from 79% to 100% across the various nursing assessment tools and from 58% to 98% across the various functional assessment tools.

Information on predictive validity was included for seven nursing and five functional assessment studies. An operational definition to identify a threshold or cut-off score above which the patient would be described as being at high risk was provided for 10 nursing and five functional assessments. Dichotomizing patients into high- and low-risk categories allows for the calculation of sensitivity and specificity of the scale. Five functional assessment studies reported sensitivity and specificity, whereas eight of the 15 nursing studies reported them. Reported sensitivity varied from 43% to 100%, and specificity varied from 38% to 96% across all assessment tools combined. The median sensitivity scores were 81% and 85% for nursing and functional assessment tools, respectively. The median specificity scores were 75% and 78% for nursing and functional assessment tools, respectively.

Classifying patients into risk categories also enables clinicians to link risk assessment with specific interventions.

Table 3. Commonality of Patient Characteristics Assessed Across Nursing Assessment Tools

Patient Characteristic	Number of Studies	Specific Studies Utilizing Parameter (numbered as listed in reference section)
Mental status or cognitive impairment	13	21–25,27,35,36,38–41,44
History of fall	10	21,22,24,25,27,35,38–41
Mobility impairment	10	21–23,25,27,35,39–41,44
Secondary or specific diagnoses known to affect fall risk	8	21,23,25,27,38,40,41,44
Incontinence or difficulties with toileting	8	22,24,25,27,35,36,40,44
Medications known to affect balance/cognition or polypharmacy	7	24,27,35,38,40,41,44
Sensory deficits (e.g., vision, hearing, or sensation)	7	22,24,27,38,40,41,44
Balance impairments	5	25,39–41,44
Age	4	24,27,36,40
Activities of daily living limitations	4	21,38,41,44
Physical status (e.g., weakness or amputation)	4	24,27,40,41
Use of assistive devices	4	21,27,39,41
Gender	3	23,27,36,44
Acuity of illness	3	21,44
Use of restraints	1	41

Seven of the 14 nursing assessment studies (21,24–27,35,36) suggested interventions linked to risk assessment scores to varying degrees.

Discussion

Use of quick, reliable, and valid fall risk screens to identify high-risk patients and to trigger further fall-related assessments and interventions is important for each clinical practice setting. They can play a crucial first step in implementing an effective and efficient fall prevention program. We recommend using the following criteria for choosing the most appropriate assessment tool for a specific setting: high sensitivity, specificity, and interrater reliability; similarity of patient population to ones in which the instrument was developed or studied; written procedures explicitly outlining appropriate use of the form; reasonable time required to administer the scale; and established thresholds identifying when to initiate interventions. These criteria apply regardless of setting, but the specific instrument chosen might vary depending on the setting and professionals responsible for completing the forms.

Fall Risk Assessment in Acute Care Settings

In the acute care settings, time to complete the form is a critical criterion due to the repeated assessment required during an inpatient stay. Acuity of illness and medication changes will affect mobility, physical status, and cognition, and these parameters will vary considerably within and between shifts. This requires an assessment that is easy and quick to complete to facilitate repeated assessment without burden to acutely ill patients. Therefore, nursing assessment scales seem the most appropriate approach for this setting. Of the 14 nursing assessment tools reviewed, only 2 (22,35) have both sensitivity and specificity above the median (81% and 75%, respectively). Five (21,22,25,35,40), however, have sensitivity and specificity both greater than 70%. Of these five tools, only two described how long it takes to complete (<1 min), and only one has been replicated in publications by other investigators (42).

Fall Risk Assessment in Outpatient Settings

In outpatient settings, acuity of illness and medications do not generally vary much within short time periods, but mobility and balance are quite predictive of falls. Consequently, functional assessment tools may be more appropriate within outpatient settings. Two assessment tools, the Elderly Fall Screening Test (34) and the Timed Up & Go (37), have both sensitivity and specificity above the median (85% and 78%, respectively), but the Timed Up & Go test is considerably quicker (<1 min) than the Elderly Fall Screening test (17 min).

Fall Risk Assessment in Extended Care Settings

In the extended care setting (e.g., nursing homes and rehabilitation units) where the majority of patients may be at high risk, applying universal precautions for falls may be more appropriate than relying on individual assessments, especially when nursing and rehabilitative interventions are already being utilized. The vast majority of patients in these types of settings will score as high risk on either nursing assessment tools, like the Morse Fall Scale (21), or on functional assessment instruments, like the Timed Up & Go (37). Consequently, the time, even as short as it is to complete either of these tools, may be better utilized for implementation of an overall fall prevention program rather than screening patients because the vast majority of patients in the extended care settings may be deemed high risk.

Conclusions

In summary, a substantial number of fall risk assessment tools are readily available, most with evidence supporting their reliability and validity. Many report explicit details on how to complete the form and the time involved. Thus, it should be possible to find a scale that can be used with confidence as the initial component to an effective falls prevention program. Consequently, there seems to be little need for facilities to develop their own scales de novo, which may in fact be counterproductive to the overall goal of fall risk assessment because scores and scales would not be comparable across similar types of facilities.

Different types of setting (e.g., acute care, outpatient, and extended care), however, should probably use different assessment scales. In general, nursing assessment tools, which assess intrinsic characteristics of the patient, are most appropriate and efficient in the acute care setting. Functional

assessment instruments, focusing primarily on mobility and/or balance assessment, are most appropriate for the outpatient setting where functional status is very predictive of fall risk status (28). In the extended care setting where nearly every patient is at high risk for falls, screening may not actually be advantageous because a universal-precautions fall prevention program may be most efficient. Whereas this would allow scarce staffing resources to be used for fall prevention interventions rather than fall risk assessment, further study is needed to determine the overall effectiveness of such universal fall precautions.

Although a variety of adequate screening tools are available, further research is needed in a number of areas, including defining their optimal frequency intervals (which would be related to acuity and to the changing medical condition of the patient), determining the most appropriate cut-off thresholds for fall risk, defining how to link interventions with specific fall risk factors, and determining the effectiveness of different fall prevention strategies.

Acknowledgments

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