Development and Validation of a Fall Prevention Knowledge Test

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Falls are a serious, persistent problem in hospitals. Ensuring that all hospital staff have adequate knowledge of how to prevent falls is the first step in prevention. We identified validated fall prevention knowledge tests (FPKTs) and planned to conduct a systematic literature review. When the review identified a lack of FPKTs, we developed and evaluated a FPKT, confirmed its conceptual framework, identified the content domain, drafted test items, devised the format, selected items for empirical examination, and conducted a psychometric evaluation. We randomly divided a 209-subject data set into test and validation samples to make item reduction decisions and examine reliability and validity. The typical respondent was a white, 42-year old female nurse with a bachelor's degree and 7 years' experience. Subjects were confident in their ability to prevent falls, rating themselves an 8 on a self-efficacy scale of 1 (not at all) to 10 (very). The 11-item FPKT scale (range 0–11) attained a tetrachoric coefficient of 0.73, confirming initial reliability. FPKT mean scores obtained before and after fall prevention education improved from 5.1 ± 1.8 to 6.6 ± 1.7. Statistically significant differences (paired t-test = 12.4, $p < .001$) confirmed validity. A robust way to assess nurses' knowledge of fall prevention is needed to inform effective educational programs. Addressing gaps in validated FPKTs provides an opportunity to inform and evaluate effective fall prevention programs. **J Am Geriatr Soc 00:1–6, 2018.**

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Falls are a common adverse event in hospitals. Approximately 3% of hospitalized individuals fall, and approximately 25% of those who fall sustain an injury[1]. Our team developed a program, Fall Tailoring Interventions for Patient Safety (TIPS)[2], based on a decade of fall-prevention research including a randomized controlled trial that demonstrated a 25% reduction in falls in hospitalized individuals[3]. Fall TIPS brings customized evidence-informed preventative interventions to the bedside.

We are developing a comprehensive toolkit to facilitate use of Fall TIPS, and a fall prevention knowledge test (FPKT) is a necessary component. Therefore, we performed a systematic literature review to identify validated FPKTs. We found no published reviews of the literature evaluating FPKTs, so we developed and psychometrically evaluated a FPKT.

METHODS

This study is part of a larger project to evaluate the Fall TIPS program (1R18HS025128–01) funded by the Agency for Healthcare Research Quality (AHRQ). The Partners HealthCare human subjects committee approved the protocol.

Literature Review

With the assistance of a medical librarian, we searched the literature published between July 1987 and July 2017 to identify FPKTs designed for hospital use. We used the search terms accidental falls, staff development, nursing/hospital staff, medical/hospital staff, teaching, education, patient safety, risk management, staff knowledge, interprofessional education, education, continuing education, causes

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of falls, fall prevention, fall risk, falls risk, intervention, interventions, program, pre-and post, survey, program, tool, tools, validated, assessment, functional, clinical assessment tool, scores/scoring, and scale/scaling. We searched terms in combination in the PUBMED, CINAHL, and EMBASE databases and Google Scholar and established 3 inclusion and 5 exclusion criteria. Articles had to be written in English, peer-reviewed, and related to fall prevention. Articles would be excluded if they did not mention a FPKT in the article, compare knowledge of fall prevention with that of a related concept, describe development of the test, report statistical validation of the test, or provide the knowledge test reported in the article.

Development of the FPKT

The tenets of classical measurement theory[4] directed FPKT development and ensured conceptual, operational, and empirical adequacy. Our process consisted of four steps: confirm conceptual framework to identify FPKT's content domain, draft initial test items for FPKT consideration and plan FPKT format, determine inclusion items for prototype FPKT to be examined empirically, and conduct psychometric evaluation.

Conceptual Framework

Two components informed the conceptual framework: the literature base and our team's program of fall prevention research. Decades of fall prevention research (see selected reviews[5,6] have aimed to prevent people from falling, yet hospitalized individuals continue to fall and sustain injuries[7]. Our team's program of research (see selected reports[8–11] led to the first published randomized controlled trial in the United States that successfully tested an intervention that reduced falls by 25% in acute care hospitals[3] and a subsequent study identifying why some individuals who received the intervention fell[12].

We concluded that falls result from communication problems that can be addressed using 3 low-technology, straightforward, inexpensive "steps" that are easily integrated into the workflow of nursing staff to prevent patients from falling[2]. This 3-step fall prevention process undergirds the FPKT. 1) The nurse, in collaboration with the patient (and family when available), conducts a fall risk assessment using a reliable, valid screening scale to identify risks for falling. 2) Using those assessment findings, the nurse engages the patient in development of an evidence-informed tailored fall prevention plan and makes the plan available to all stakeholders. 3) All stakeholders accurately and consistently implement the customized fall prevention plan and universal fall prevention strategies[2].

Initial Test Items

We drew on the extensive fall prevention literature base addressing the conceptual framework's 3 components to specify the item pool to be considered for the FPKT. Two doctorally prepared nurses with extensive experience in fall prevention research (PCD, ACH) independently identified items for FPKT inclusion. Using the following set of guidelines, we compared, combined, and refined potential items and identified 28 items that caregivers should know and integrate into care plans to prevent hospitalized individuals from falling. The literature had to support the correct response for each item. All items would be 1- or 2-sentence statements (some correct, some incorrect) to be answered as true or false to avoid measurement errors from misreading the stem of the item or having potentially confusing response selections. There would be no double negatives. No question would provide an answer to another question.

Specific Items to Be Included for Empirical Evaluation

We used a combination of 2[4,13] sets of validity criteria and planned for 2 phases of testing to identify items that should be retained, refined, or deleted. In Phase 1, 28 items were submitted to team members of the aforementioned AHRQ-funded study to evaluate the Fall TIPS program. These fall prevention researchers (7 nurses, 2 physicians, 1 research scientist) independently reviewed each item and made suggestions for refinement or deletion. During 2 conference calls, group consensus was used to refine 27 items and delete 1.

In Phase 2, the 10 researchers critiqued the 27 items (see Fall Prevention Knowledge Test, (Supplementary Appendix S1) using 4 criteria in 2 categories: 1) substantive: a) essential (core fall prevention knowledge), b) discriminates (item differentiates clinicians with fall prevention expertise from those without) and 2) procedural: c) clear (item is correctly interpreted as written); d) duplicative (item is similar to another item; reverse coded for analysis). Judges rated each item as yes (scored 1) or no (scored 0) and provided comments and suggestions for rewording. To be retained, an item had to achieve a summed score of 14 or greater (range 0–20) on combined substantive and procedural criteria. Eighteen items were retained. Revisions were suggested for 11 items. During the third conference call, the 18 items as revised were discussed, refined according to suggestions, and confirmed as the prototype FPKT to be tested empirically.

Psychometric Evaluation

We conducted 2 phases of empirical examination to make item reduction decisions and analyze scale psychometrics. Data were obtained from subjects (mostly clinical nurses) in 5 sites located in 3 states in 2017–18. Subjects at each site received education on the Fall TIPS program[2]: in New Jersey, 57 attended an all-day hospital association meeting; in New York, 11 members of fall prevention teams attended a 3-hour program; and in Massachusetts, 32 Nursing Practice Committee members attended a 4-hour program, and 109 fall prevention nurse champions from 2 academic medical centers attended a 3-hour program. Subjects completed the FPKT before and after the educational program and had to provide anonymous information to link the 2 FPKTs to be included in the dataset (N=209). We randomly split the dataset and analyzed data from the first random sample (n=104), the test sample, to make item reduction decisions using 3 a priori criteria: pretest items that 90% or more scored correctly (n=4), pretest items that 10% or less scored correctly (n=0), and posttest item scores less than pretest scores (n=3). By removing those 7 items, we anticipated that the retained 11 items would have the capacity to capture a change in knowledge after education without a celling or floor effect. We then examined the 11-item FPKT with the second random sample (n=105), the validation sample (Table 1).

Analytic Plan

We examined the 11-item FPKT for internal consistency and construct validity. We aimed to achieve an alpha coefficient of 0.7 or greater, the value considered adequate for a new scale[23]. Because the FPKT is a dichotomous scale, we created an alpha coefficient using tetrachoric correlations to examine reliability[24] using the SAS statistical program (SAS Institute, Inc., Cary, NC). All other data were analyzed using SPSS (IBM Corp., Armonk, NY). For construct validity, we used the paired t-test statistic to examine FPKT scores[4], anticipating significantly higher scores after the educational intervention. We explored potential relationships between subject characteristics and FPTK scores, including subjects' self-efficacy to prevent falls compared with their peers in our previous work we found that nurses report high levels of fall prevention self-efficacy[11]).

RESULTS

Literature Review

We retained 402 articles after removing duplicates and assessed titles and abstracts for eligibility. One hundred sixty-three articles did not meet established inclusion criteria, resulting in 239 retained articles. We then assessed full texts of the remaining articles. An extensive review by 2 authors (MD, SK), excluded all 239 articles because they had 1 or more exclusion criteria; 196 articles did not include a fall prevention knowledge test, and 29 of the remaining 43 were excluded because they tested staff self-efficacy for fall prevention rather than knowledge. Of the 14 remaining articles, we excluded 6 because the test was not included in the article. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses diagram and the 8 articles that

Table 1. Fall Prevention Knowledge Test Items and Rationale for Correct Response

1. Bedside nurses know their patients and are better than a standardized screening scale at identifying patients likely to fall. False, because nurses' clinical judgment depends on individual experience and expertise, and bedside nurses have different levels of nursing expertise, which leads to variation in clinical judgement and decision-making[14]. The use of a validated fall risk assessment combined with clinical judgment is the most accurate way to predict fall risks[15]. Therefore, a standardized screening scale would work better at identifying patients likely to fall.
2. The 3-step fall prevention process comprises 1) screening for fall risks, 2) developing a customized fall prevention plan, 3) completing fall prevention documentation. False, because all 3 phases require patient involvement versus "documenting." The 3-step fall prevention process comprises 1) screening for fall risks in collaboration with the patient, 2) engaging the patient in developing a customized fall prevention plan, and 3) implementing the plan consistently with the patient and family[2]. Patients fall when not everyone follows the customized fall prevention plan[12].
3. A 75-year-old man with a history of recent falls and osteoporosis is admitted for severe abdominal pain. His is at greater risk for injury if he falls because of his age. False, because the factor for greater risk for injury because of age is for patients aged 85 and older, according to the Institute for Healthcare Improvement ABCS of harm[16], although this man is at greater risk of injury because of his history of osteoporosis[17].
4. A common reason why hospitalized individuals fall is that their fall prevention plan is not followed. True, because in a randomized controlled clinical trial,[3] when patients in the intervention arm fell, it was because their fall prevention plan was not followed[12].
5. Falls can be prevented in patients who are susceptible to falling because of physiological problems by providing a safe environment (e.g. clear path to bathroom, room free of clutter, good footwear). False, because negative consequences of identified physiological problems that predispose to falling can be ameliorated using targeted interventions[18] (in addition to universal precautions)
6. Patient engagement in fall prevention means that the nurse completes the fall risk assessment and prevention plan and then teaches the patient about their personal fall risk factors and prevention plan. False, because research has found that engaging patients after completing the first 2 steps of the fall prevention process is inadequate. Patients must be engaged from the beginning of the process to improve the likelihood that they will follow their plan[2,9,10].
7. All hospitals are different, so they should develop their own fall risk assessment forms. False, because risk assessment tool development requires a rigorous, scientific approach[19]. It is better to use a standardized assessment form[15] than to "reinvent the wheel." There are thoroughly researched fall risk assessment tools with adequate reliability, specificity, and sensitivity[20].
8. A fall risk screening scale identifies individuals who are likely to fall because they have one or more physiological problems. True, because there are 3 types of falls: 1) accidental, 2) anticipated physiological, and 3) unanticipated physiological. Taking universal fall precautions can prevent accidental falls. A fall risk assessment scale is completed to identify physiological problems that can lead to a fall. Once fall risks due to physiological problems are identified, they are "anticipated" and can be prevented using a customized prevention plan[18]. Fall risk screening scales are used to identify patient-specific physiological factors that are the most common risks for falls[20,21].
9. When nurses communicate with patients about their risk of injury if they fall, this improves the likelihood that patients will follow their personalized fall prevention plan. True, because research has shown that, if people believe that they could be injured in a fall, they will be more likely to follow the fall prevention plan while hospitalized. Through our research with implementing Fall TIPS, we found that people are more likely to follow their fall prevention plans if they are aware that they are at greater risk of injury if they fall[2].
10. Patients at low risk for falls do not require a fall prevention plan. False, because even patients at low risk of falls can fall. Low risk does not mean no risk. Patients with any risk factor for falling require a preventative intervention to mitigate that risk[3].
11. Bed and chair alarms should be activated for all patients who screen positive for being at a high risk of falling. False, because not all patients who are at risk of falling need bed alarms, and they should not be used indiscriminately. Bed and chair alarms are ineffective at preventing falls in patients who do not have a mental status risk factor (e.g., confused or will not reliably call for help when needed) and only serve to contribute noise to the environment[22].

contained a fall prevention knowledge test are included in Supplementary Appendix S2. Although none of these fall prevention knowledge tests were consistent with our criteria, they helped guide the blueprint for the FPKT reported in this article. Articles were excluded for the following reasons. Four did not examine validity because of the mixed format or open-ended nature of the test items[a-d]. One had a sample of only 27 nurses and did not report validity[e]. Another reported administration of the test to 560 nurses but without validation of the selected risk factors and interventions included in the test[f]. AHRQ[h] has been adopted a 14-question multiple choice test that the Singapore Ministry of Health[g] developed but there are no reports validating this test. Because we were unable to locate a valid, reliable, peer-reviewed test to assess fall prevention knowledge of hospital staff, we developed the FPKT.

Subjects

There were no statistically significant differences between subject (varying numbers responded to each question) characteristics in the 2 randomized data sets (test, n=104; validation, n=105), so we describe all 209 subjects. The typical respondent was a white (78.6%), female nurse with a median age of 42 (range 22–68), a bachelor's or higher degree (86.4%), a median of 7 years of experience as a registered (range < 1–48), and a median of 4 years of experience at current hospital who worked a median 32 hours a week, mostly Monday to Friday (35.4%), on the day shift (28.5%), providing direct patient care (30.6%) or was in leadership management (30.6%). Subjects were confident in their ability to prevent patients from falling. The median score for 179 respondents who reported their confidence to prevent falls (self-efficacy to prevent falls) on a scale from 1 (not at all) to 10 (very) was 8, and 70.7% believed that their ability to prevent falls was equal to or greater than that of their peers. There was no relationship between total FPKT score and self-efficacy to prevent falls and knowledge of fall prevention (correlation coefficient=0.044, p=.69).

Psychometric Evaluation of the FPKT

FPKT scale reliability assessed using the tetrachoric coefficient was adequate, achieving 0.73 in the validation sample. Validity of the FPKT was also adequate. Individual item scores were greater at post-test for the FPKT scale total score in the test, validation, and combined samples.

Although our intention is that the 11-item FPKT be used to assess staff knowledge of fall prevention for hospitalized individual, each item is important and represents a component of needed educational interventions. Thus, we examined the 11 items individually for percentages answered correctly and paired t values. This provided construct validity by showing that scores on most individual FPKT items improved after education (Tables 2–3). The three individual items that did not improve in the validation sample after education suggest a need for improved education in those areas.

The 11-item FPKT has a range of 0 to 11 and was normally distributed in the test, validation, and combined samples (Table 3). Although overall FPKT scores improved significantly after education, the post FPKT Mean Scores were only 6.6, indicating that there is much room for improvement.

We sought to identify predictive variables that might explain FPKT scores to facilitate targeting specific groups that would benefit from enhanced fall prevention education. We used cross-tabulations of FPKT scores with self-efficacy scores and demographic variables in test, validation, and combined samples and found no associations.

DISCUSSION

We systemically reviewed the literature and could not locate a validated hospital-based FPKT. We then developed and evaluated a FPKT. The refinement of FPKT items during the development phases ensured content validity because a panel of experts agreed that individual items contributed to operationalizing the 3-step fall prevention process. To our knowledge, this FPKT is the first rigorously developed and psychometrically evaluated test available. The FPTK is suggested for assessing nursing staff knowledge of fall prevention in acute care settings.

Nurses provide most clinical care of older persons in hospital settings. Even though nurses report high levels of fall prevention self-efficacy[11], falls are a common adverse event in hospitals[1]. Even with relatively low FPKT test scores (mean of 6.6 of potential 11 in the combined post-

Table 2. Correct Responses to 11 Fall Prevention Knowledge Test Items

Item	Test		Validation	
	Before	After	Before	After
		%		
1. Nurse judgment not better than standardized scale	49	63	61	61
2. Components of 3-step fall prevention process	20	49	20	44
3. 75-year-old man at injury risk from fall because of age	37	73	41	66
4. Hospitalized individuals fall because plan not followed	77	88	87	93
5. Prevent falls due to physiological problems by safe environment	14	24	16	22
6. Patient engagement in fall prevention	21	38	15	27
7. Hospitals should develop fall risk forms	72	85	77	84
8. Fall risk scale identifies individuals likely to fall	77	87	84	86
9. Knowing injury risks improves after plan	87	99	91	87
10. Individuals at low fall risk for falls do not need plan	87	89	91	86
11. Bed and chair alarms for all individuals at high fall risk	25	55	30	63

Table 3. Fall Prevention Knowledge Test Mean Scores and Paired T-Test Values

	Test Sample, n=104		Validation Sample, n=105		Combined, N=209	
Analysis	**Before**	**After**	**Before**	**After**	**Before**	**After**
Mean±standard deviation	4.9 ± 1.8	6.7 ± 1.8	5.3 ± 1.8	6.6 ± 1.6	5.1 ± 1.8	6.6 ± 1.6
Paired t-test	t=10.23, p<.001		t=7.44, p<.001		t = 12.4, p < .001	

test sample), the fact that nurses were unrealistically confident (self-efficacy score of 8 out of 10) in their ability to prevent falls further signifies the need for a valid FPKT that can adequately assess knowledge of core fall prevention concepts. A robust way to assess nurses' knowledge of fall prevention is needed to inform effective educational programs.

We had some unexpected findings. We made item reduction decisions based on a randomized half of the data set (n=104) obtained from all sites and then used the other half (n=105) as the validation sample. One of our exclusion criteria was that items would be deleted if the percentage of correct responses after an educational intervention was lower than the pretest percentage. Two items (9 and 10) each had higher pre- than post-test scores in the validation sample. More than half of the test and validation samples answered 3 items (2, 5, 6) incorrectly. Because these 3 items (knowing the 3-step fall prevention process, incorrectly believing that falls can be prevented using universal precautions, need for engagement with the patient in the fall prevention process) are crucial concepts, education must be improved.

Although one could argue from a psychometric point of view that future FPKT users should delete these items, resulting in a more parsimonious scale, we believe that the concepts are so important that they should be retained. For example, item 6, "Patient engagement in fall prevention means that the nurse completes the fall risk assessment and prevention plan and then teaches the patient about their personal fall risk factors and prevention plan," is intended to capture the essence of fall prevention. The correct response is false because the nurse should include the patient as an active participant in the assessment and plan (vs excluding the patient in conducting the assessment and placing the patient in a passive role of being taught the plan that the nurse decides on). An effective fall prevention plan (item 2) involves the patient as an active participant in all three phases of fall prevention: conducting fall risk assessment, planning evidence-informed interventions, and carrying out the plan. Patient engagement does not mean the nurse performs the assessment and then informs the patient about "what to do." Patient engagement involves patients as active partners in their care[25], leading to better health outcomes in general and preventing falls in particular[26]. Because these data were analyzed after all the educational sessions were complete, there was not an opportunity to change the sessions to better emphasize these concepts. Future educational programs should place greater emphasis on the distinction between patient education and patient engagement and on the importance of engaging patients (and family) in all 3 steps of the fall prevention process. Continued use of the 11-item FPKT will allow us to evaluate the effectiveness of these items.

We developed the FPKT for use in acute care hospitals, but in the future, we suggest examination for use with nurses who care for individuals in other settings including long term care sites, day care, homes, urgent care centers, and emergency departments. In addition, the FPKT could be modified to be specific for other interdisciplinary professional and paraprofessional members of the healthcare team. The original 27 items examined for empirical evaluation" (Supplementary Appendix 1) should be considered for additional work to understand professionals' beliefs about falls and how they might affect fall prevention behaviors. Knowledge of and beliefs about the central core of Fall TIPS, patient engagement in the 3-step fall prevention process, should be further explored, as well as development of a fall prevention core curriculum for use in conjunction with the FPKT.

Limitations

This study has several limitations. All subjects were interested in fall prevention and invited to the educational programs, and they represent a self-selected attendance. These subjects could differ from typical nurses in a hospital setting, although demographic variables were similar to those in the most recent data (2013) that the Bureau of Health Professions has compiled,[27] except for educational preparation. In the FPKT study, 92% of the subjects had a bachelor's degree or higher (in 2017–18), versus 55% in the United States (in 2013)[27]. Lastly, different faculty taught at the 5 sites, and the educational interventions ranged from 3 hours to an all-day program. Although one could argue that this approach compromised intervention fidelity, the purpose was to evaluate the psychometric properties of the FPKT and not examine the effectiveness of an educational intervention.

Conclusions

Knowing how to prevent falls is clearly insufficient to prevent falls, but not having the basic knowledge necessary to prevent falls may be a contributing factor and can be addressed through educational programs. A validated FPKT provides a tool to inform and evaluate hospital-based fall prevention programs.

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Author Contributions: PCD, ACH, MB, JSA: study design. PCD, ACH, SL: statistical analysis. EJC, EMJ, MEL, MS, SPY: acquisition of subjects and data. All authors: drafting and revision of manuscript. PCD is the guarantor and takes responsibility for the integrity of the data and accuracy of the data analysis.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

Supplementary Appendix S1. Fall Prevention Knowledge Test-Validity Testing Packet

Supplementary Appendix S2. Fall Prevention Knowledge Test PRISMA diagram and list of reviewed articles