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PAPER

Review of the Evidence on Falls Prevention in Hospitals

Task 4 Final Report

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HEALTH

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Abstract

To facilitate the development of a hospital falls prevention resource guide, we systematically reviewed and documented the existing evidence base for interventions to prevent falls in hospitals, provided an overview of the performance of existing tools with known measurement properties, and compiled available online resources.

The search identified a large number of published fall prevention intervention evaluations. Almost all interventions were multi-component in nature and included fall risk assessments and education for staff and patients and/or families. Intervention complexity and organizational implications varied widely. The review also identified a wide variety of tools for the prevention of falls in hospitals; the majority of the documented tools were fall risk assessment scales. Very few tools, such as the Morse Fall Scale and the STRATIFY scale, have been applied in a number of studies and have generalizable reliability and validity estimates.

The documented evidence-based interventions and tools may assist in the development of programs to prevent falls in hospitals. Which tools and interventions are suitable for use in individual hospitals must be evaluated in the context of existing approaches, resources, and individual needs. The identified material will be integrated into the AHRQ toolkit as resources to guide fall prevention approaches for hospitals.

Introduction

To facilitate the development of a hospital falls prevention resource guide, we systematically reviewed and documented the existing evidence base for interventions to prevent falls in hospitals, provided an overview of the performance of existing tools with known measurement properties, and compiled available resources.

There are a number of potentially relevant resources available to support the prevention and reduction of falls in hospitals. To scan available resources we compiled a list of example toolkits and existing networks that are available online. These potential resources were identified through existing toolkits, ”how-to” guides and clinical guidelines, and an internet search (Google search engine, August 2011). In addition, we consulted the research team and project leads of successful approaches, and searched our personal files to identify potentially useful resources. This list of available resources is shown in the appendix (see Published resources). The list of resources is not exhaustive but it shows that a substantial number of existing toolkits and clinical guidelines for falls prevention are available, for example information published by other countries and health agencies. The resources listed are available online and often contain example tools and descriptions of falls prevention initiatives. However, what is needed to successfully implement a falls prevention program often goes beyond access to potential interventions and tools and more guidance is needed.

The toolkit commissioned by the Agency for Healthcare Research and Quality (AHRQ) is designed to help guide the implementation of a multi-faceted hospital falls prevention program. It will show example interventions and tools but its focus is on the process for implementation of these interventions and tools. The guide should allow hospitals at different stages of falls prevention implementation to select components that are needed to successfully prevent patient falls with programs that are tailored towards their specific situations.

To effectively support the creation of the AHRQ-commissioned toolkit, our evidence review compiles evaluations of interventions and tools aimed at preventing or reducing falls specifically in the hospital setting. The review was performed by the Southern California Evidence-based Practice Center (EPC) based at RAND. The evidence review was conducted using EPC principles to produce a concise and structured overview of falls prevention interventions, tools, and other resources. To this end, the scope and inclusion criteria were specified, the searches were documented, and the available evidence was structured in evidence tables and annotations showing pertinent characteristics of approaches, tools and resources.

This report summarizes the results of the evidence review that supports the toolkit / resource guide for falls prevention in hospitals.

Evaluations of interventions

For this review we aimed to systematically collate evaluations of hospital fall prevention interventions. There are a number of risk factor studies and conceptual papers that have outlined

potential risk factors for falls. Some of these risk factors have been translated into interventions to prevent falls in hospital settings. For this review of the evidence we focus on these evaluations of hospital fall prevention interventions in order to identify promising evidence-based approaches; risk factor studies and interventions not yet tested in hospital settings were outside the scope of the review.

Search and review sources

A number of pertinent reviews have addressed the prevention of falls. These reviews were used to identify evaluations of approaches to prevent falls in hospitals. We have identified reviews describing hospital relevant interventions by searching the Database of Abstracts of Reviews of Effects (DARE), the Cochrane Database of Systematic Reviews, PubMed applying a systematic review search filter, and personal files. In addition, existing falls prevention toolkits and guidelines were screened.

The following reviews and reports were used to identify primary studies:

- American Geriatrics Society, British Geriatrics Society, and American Academy of Orthopaedic Surgeons Panel on Falls Prevention (2001): Guideline for the prevention of falls in older people / Panel on Prevention of Falls in Older Persons; American Geriatrics Society and British Geriatrics Society (2010): Summary of the updated American Geriatrics Society / British Geriatrics Society Clinical Practice Guideline for Prevention of Falls in Older Persons
- Australian Commission on Safety and Quality in Healthcare (2009): Preventing falls and harm from falls in older people: Best practice guidelines for Australian hospitals.
- Boushon et al. (2008): Transforming care at the bedside How-to guide: Reducing patient injuries from falls
- Cameron et al. (2010): Interventions for preventing falls in older people in nursing care facilities and hospitals (Review)
- Choi et al. (2011): Developing a multi-systemic fall prevention model, incorporating the physical environment, the care process and technology: a systematic review
- Coussement (2008): Interventions for preventing falls in acute- and chronic-care hospitals: A systematic review and meta-analysis
- Duckers et al. (2009): Safety and risk management interventions in hospitals: A systematic review
- Evans et al. (1999): Fall prevention: a systematic review / Evans et al. (1998): Falls in acute hospitals: A systematic review
- Gillespie et al. (2003): Interventions for preventing falls in elderly people (Review)
- National Patient Safety Agency (2007): The third report from the Patient Safety Observatory. Slips, trips and falls in hospital
- Oliver et al. (2000). Do hospital fall prevention programs work? A systematic review
- Oliver et al. (2007): Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: systematic review and meta-analysis
- Oliver et al. (2010). Preventing falls and fall-related injuries in hospitals.
- Shekelle et al. (2003): Falls prevention interventions in the Medicare population; Chang et al. (2004): Interventions for the prevention of falls in older adults: systematic review and meta-analysis of randomised clinical trials

- Shojania et al. (2001): Making health care safer: A critical analysis of patient safety practices
- Stern et al. (2009): Interventions to reduce the incidence of falls in older adult patients in acute-care hospitals: a systematic review

In addition, primary studies were identified by searching the databases PubMed, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and the Web of Science for studies published in recent years and not yet captured by existing comprehensive hospital fall prevention reviews. A 2007 systematic review by Oliver, for which the search was conducted in 2005, was most similar in scope to the needs of the present project. Unlike other pertinent overviews, the review by Oliver et al. (2007) included not only randomized controlled trials (RCTs) but also non-randomized trials and before-after studies. We limited our search to the publication period January 2005 to August 2011. We used a combination of free text words and the MeSH term 'Accidental falls' restricted to hospital settings and English language publications.

The outlined search strategy was not restricted to a set of known interventions and was deliberately kept broad to identify diverse approaches. These may include multi-faceted approaches, the identification of high risk patients through assessment scales, prevention of delirium, minimization of psychoactive medications, scheduled toileting, education for family and staff, attention to environmental safety at the bedside, bed alarms, and other interventions with the aim to prevent falls identified in the toolkit scope, as well as novel interventions. Interventions primarily aiming to prevent injuries from falls, such as osteoporosis prevention approaches, hip protectors, vitamin D and calcium supplementation, were not reviewed unless combined with an explicit approach to prevent falls themselves.

The search was restricted to hospital settings and excluded long-term care facilities (e.g., nursing homes) to ensure that documented interventions are likely to be applicable to the majority of settings targeted in the toolkit. Long-term care facilities can establish long-term interventions that require continuity and the facilities tend to have a more homogeneous group of patients with a higher prevalence of patients at risk of falling. Therefore, results from fall prevention interventions targeting long-term care facilities may not generalize to acute care settings.

The electronic search retrieved 2473 publications. The full search strategy is documented in the appendix (see Search strategy). Studies were also identified through reference mining of included studies, from our personal file collection, and through consultation with the research team and experts in the field of hospital-based fall prevention. A list of the contacted project leads is shown in the appendix (see Contacted project leads).

Inclusion and exclusion criteria

Our aim was to identify evaluations of fall prevention interventions applicable to hospital settings.

Participants: Studies aiming to test interventions to reduce falls in hospitalized patients regardless of the patients' age or risk status were eligible for inclusion. Studies to reduce falls among staff, community-dwelling patients visiting the hospital for treatments (outpatients), or day hospital participants were excluded.

Interventions: Eligible interventions had to be aimed at falls reduction in the hospital to be included in the review. Single and multi-component approaches were considered. Studies evaluating discharge planning interventions with outcomes focusing on the time after the hospital stay and outpatient programs were not sought. Studies evaluating the reduction of restraint and bedrail use were excluded unless combined with other interventions aiming to reduce falls. Studies on interventions aiming to reduce the risk of injuries from falls and limiting the impact of falls were not sought unless they were combined with a falls prevention approach. Studies reporting on the outcome of falls for intervention evaluations where the intervention was not primarily aimed at falls reduction (e.g., as a byproduct) were not sought for this review.

Comparator / design: Studies that reported a concurrent or historic comparator (randomized controlled trials, controlled clinical trial, cohort studies comparing two cohorts, before-after studies, time series) for the outcome 'falls' in the hospital were eligible for inclusion in the review. Descriptions of interventions without data or without comparators were not considered. Case studies of individual patients were excluded.

Outcome: To be included in the intervention review, studies had to report on accidental falls during the hospital stay for an intervention and a control group. Only studies reporting numerical data on the treatment and the control group, or data on the falls reduction or falls rate reduction in comparison to the comparator were considered. Examples of included outcomes are the number of patients who fell at least once; the number of falls; and falls rates, such as the monthly rate of falls, for a specified number of inpatient days. Evaluations plotting falls events on graphs without reporting numerical data, publications reporting only a range of reductions across hospital departments without exact incidence data for a treatment and a control group, and publications reporting only a descriptive and non-numerical assessment of the intervention results ("fall rates improved") were not eligible for inclusion in the evidence review. Studies reporting on other outcomes such as falls after discharge or other long-term effects were also not sought.

Setting: We restricted eligible studies to hospital settings. Studies aimed at nursing homes, residential care facilities, and other long-term non-hospital care facilities were excluded.

Data abstraction

For this review, we abstracted data from studies in settings that included acute care hospital units. The identified interventions should be applicable in a variety of care settings but most importantly for the purposes of the AHRQ falls toolkit, they have been tested in acute care settings, an environment that does not necessarily have the set up and resources available in long-term care facilities. These studies are presented in an evidence table (Table 1) to enable a concise overview of interventions and their success in preventing falls.

In the course of the review, we also identified some interventions exclusively evaluated in subacute hospital settings, such as rehabilitation centers, but we did not review these studies in detail. Where necessary to identify the setting, we checked the average length of stay: Studies in which patient stays exceeded 30 days were classified as occurring in subacute hospital settings. The comparability and transferability of success of interventions suitable in subacute settings and their corresponding organization and patient characteristics is unclear. The studies identified as

occurring in subacute hospital settings are listed in the appendix, together with the abstract of the publication, to allow an overview of the subacute hospital studies (see References of subacute hospital intervention evaluations).

For each acute care hospital study, we extracted the study design, the care setting, whether the evaluation was performed in an US hospital, patient characteristics, intervention categories and components, the comparator, information on the fidelity of the intervention where provided, and the results for the falls outcomes as reported by the study authors.

Regarding the setting, we extracted the type of hospital (e.g., teaching hospital) and wards included in the study. We extracted information on the patients, for example whether all admitted patients were included in the intervention or whether only selected groups such as high-risk patients were studied, and we extracted the number of patients in the intervention and the control group where available.

Regarding the intervention, we extracted the intervention components and context relevant to falls prevention (existing measures in intervention and control group independent of the tested intervention and categorized the interventions broadly (e.g., education). We extracted which tools were used in the studies and searched the literature for reliability and validity data on the tool (shown in table 2). We also indicated whether the tool was shown in full in the publication or whether factors considered in risk assessments were presented. In terms of intervention fidelity, we extracted data on the use of the introduced tools and data on the adherence to the interventions, e.g., the percent of risk assessment tools completed for all eligible patients. We extracted available falls data results as reported by the study authors together with any statistical significance tests. Where possible, we extracted the reported period of time to which the falls data refer.

Table 1 summarizes the included studies reporting on the success of falls prevention interventions in acute hospital settings. The table is subdivided into studies with concurrent controls (e.g., RCTs) and studies with historic controls (e.g., before-after studies). The references of included studies are listed in the appendix (see References of included hospital intervention evaluations in acute settings).

Table 1: Evidence Table of Interventions to Reduce Falls in Acute Care Hospitals

Note: B-A: Before-After study; CT: nonrandomized controlled trial; RCT: randomized controlled trial; n/a: not available, not reported; n.s.: not statistically significant; pts: patients; Category: E: Exercise; EQ: Equipment, RA: interventions to identify high risk patients, MF: multifaceted organizational protocols, ED: education, AF: audit and feedback; NM: Nutrition / medication; S: Signal / identification of high risk pts, R/T: Rounds and/or scheduled toileting

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
Concurrent control									
Ang et al. (2011)	RCT	An acute care hospital, 8 medical wards	No	Pts with high scores on fall risk screener; N: 1812 pts (910 intervention, vs 912 control)	Pts	Standard care plus pt education sessions based on risks identified by the Hendrich II Falls Risk Model vs standard care	(RA), ED	n/a	The fall incidence rate was 0.4% in the intervention compared to 1.5% in the control group (RR=0.29, 95% CI: 0.1–0.87)
Burleigh et al. (2007)	RCT	A general assessment and rehabilitation wards in acute geriatric unit	No	Frail elderly pts; N: 206 pts (101 intervention vs 105 control)	Pts	Vitamin D plus calcium vs Calcium	NM	Median compliance 88%	No statistically significant difference between groups on number of fallers (36/910 vs 45/912), mean number of falls, and time to first fall
Chen et al. (2010)	CT	Obstetric wards in 2 hospitals	No	Postpartum women; N: 2460 intervention pts, 2451 control pts	Equip ment	Multidisciplinary team; pt education with live demonstrations; anti-sliding pads in bathroom; bathroom lights improved vs usual care (pt education)	MF, ED, EQ	n/a	In the intervention group, the incidence of falls decreased from 14.24 per 1000 pt days before to 6.02 after; in the control group, falls increased from 13.72 per 1000 pt days before to

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
									14.05 after
Cozart (2009)	RCT	A neurology and rehabilitation unit in a VA hospital	Yes	Pts with high Morse Scale Scores N: 111 pts (51 intervention, 60 control)	Equipment, staff	8 fall prevention rooms equipped with safety equipment (low beds, bed alarms, commode, non-skid socks and slippers, hipsters, suitable lightings, bed trapeze, side rails, non-skid shower mats, falls prevention poster) vs 8 control rooms (non-skid socks, bracelets to signal fallers)	EQ	n/a	1 fall in the intervention group vs 3 falls in the control group (p=0.306)
Cumming et al. (2008)	Cluster RCT	24 elderly care wards in 12 hospitals	No	All pts on ward (all elderly); N: 2047 pts in 12 intervention wards, 1952 pts in 12 control wards	Pts, staff	Nurse- and physiotherapist-led interventions, risk assessment, review and adjustments (walking aids, eyewear, bedside environment improvements, increased supervision), liaison with other staff (medication, confusion management, management of foot problems), pt and staff education, physiotherapy, supervised balance and functional exercises, alarm (sock with pressure switch) vs usual care	MF, ED, RA, E, EQ	n/a	9.26 falls per 1000 bed days in the intervention wards vs 9.20 falls per 1000 bed days in the control wards (p=0.96)
Donald et al. (2000)	RCT	An elderly care rehabilitation ward in a community hospital	No	Elderly pts; N: 54 pts (28 in carpet, 26 vinyl floor room)	Equipment, Pts	Carpet vs vinyl floor; leg strengthening exercises plus conventional therapy vs conventional therapy	E, EQ	n/a	10 falls on carpet vs 1 fall on vinyl floor (RR=8.3, p<0.05), 4 falls in the exercise group vs 7 in the conventional therapy group

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
									(RR=0.21, p=0.12)
Dykes et al. (2010)	Cluster RCT	8 units in 4 urban US hospitals	Yes	Acute care pts; N: 5,160 pts in intervention units vs 5,104 pts in control units	Pts, clinical staff	Health information technology falls prevention tool kit (Fall T.I.P.S.) including risk assessment and printable posters; tailored bed posters above bed for pts at risk, includes status updates; pt education handouts for pt / family; plans of care automatically generated by tool kit; pt-specific alerts vs usual care (Morse Fall Scale, generic 'high risk for falls' sign above bed, education handouts for pt / family; care plan manually in paper or electronic record)	RA, ED, MF	81% adherence to daily MFS completion in control, 94% in intervention units; fall prevention tool kit outputs were printed for 93.2% of pts, with 89% adherence in placing bed poster above bed	3.15 falls per 1000 pt days in the intervention vs 4.18 falls in the control units (p=0.04)
Fife et al. (1984)	CT	4 units (1 orthopedic, 1 medical unit) in an 410-bed acute care hospital	Yes	Predominantly elderly pts; N: 538 pts in intervention unit, control n/a	Staff	Risk assessment (tool shown); orange identification arm band, call box, chart cover, and above wall; orange circle placed on incident report when fall occurred; risk/falls criteria card; audit vs usual care	RA, S, MF, AF	n/a	Within 12 weeks, 12 falls in the intervention group vs 16 falls in the control group (n.s.); falls in the intervention group 61% reduced from the same period 1 year pre-intervention
Haines et al. (2010)	Cluster RCT	18 publicly funded hospital wards	No	Hospital pts; N: intervention pts pre-: 6,070, post: 6113 post-intervention; control pts: 4,867 pre-, 4,986	Equipment	Low-low beds vs usual beds	EQ	n/a	5.25 (pre: 7.10) falls per 1000 occupied bed days in intervention wards vs 3.77 (pre: 5.14) in control wards (n.s.)

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
				post-intervention					
Haines et al. (2011)	RCT	Acute (orthopedic, respiratory, and medical) and subacute (geriatric and neuro-rehabilitation) hospital wards at 2 hospitals	No	Older adults; N: 1206 pts (401 education program, 424 material only, 381 usual care)	Pts	Multimedia pt education program combined with trained health professional follow-up vs education materials alone vs usual care	ED	n/a	7.63 falls per 1000 pt days in education program vs 8.61 in education material group vs 9.27 in usual care (n.s.)
Healey et al. (2004)	Cluster RCT	8 elderly care wards and associated community units of a district general hospital	No	Elderly pts, intervention pts with history of falls, had fallen or 'near miss'; N: n/a pre 16,746 occupied bed days in intervention (post 15, 951), pre 17,413 (post 16,577) in control wards	Staff	Risk assessment combined with new care plan (e.g., optician visit when problems with vision were identified in the risk factor screen) and guidelines (tool shown) vs usual care	RA, MF	n/a	11.38 falls per 1000 occupied bed days in the intervention group vs 19.92 in the control group. The change in the intervention group was significantly different from that in control group (RR=0.71, p=0.006)
Hunderfund et al. (2011)	CT	A neurology unit and 6 medical units in a tertiary hospital	Yes	Intervention: pts with neurologic and cerebro-vascular diseases, control: general internal medicine, gastro-enterology, and pulmonary service pts; N: n/a	Physicians, nurses	Physician fall risk assessment on admission (part of neurology electronic order set) in addition to nurse assessment (Hendrich II Fall Risk), reconciliation, documentation card, staff education, fall prevention measures as before vs standard care (nurse Hendrich II, fall prevention	RA, EQ, S	Complete risk assessments were performed in 73% of eligible patients	The fall rates declined significantly in the intervention unit from 5.69 before to 4.12 per 1000 pt days but there was no significant difference between the intervention unit and the

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
				22,492 pt days pre- and 15,794 post in intervention, 93,491 pre and 74,587 post in control wards		measures selected by nurse for high risk pts, e.g., assisting with ambulation, call light within reach, pt education, low bed position, side rails, surveillance, bed and chair alarms, sign on door)			control units during the same period
Kilpack et al. (1991)	Controlled (comparison to total hospital data) B-A	2 adult medical-surgical units (neuro-science, oncology / renal) in a tertiary care facility	Yes	Adults neuroscience or oncology / renal pts who had fallen; N: n/a 37-bed neuroscience unit, 42-bed oncology / renal unit	Nurses	Clinical nursing specialist develops written care plan for pts who fell, disseminated at change-of-shift report; risk alert signs in medical record and above bed; fall recorded on Kardex; staff risk awareness posters; staff education; audit and feedback vs usual care	AF, ED, MF, S	Of the planned interventions, 83% were implemented by the nursing staff	The fall rates declined from 4.7 to 4.4 per 1000 pt days; the all-hospital fall rate increased from 3.0 to 3.6 per 1000 pt days in the same time period
Koh et al. (2009)	Cluster RCT	2 acute care hospitals	No	Acute care pts; N: 1,122 pts (612 intervention, 510 control)	Nurses	Guideline developed, establishment of a multidisciplinary work group, educational sessions, reminder and identification systems, risk assessment (tool shown), audit and feedback vs usual care	MF, S, ED, RA, AF	Compliance with risk assessments increased from 50 to 99% ($p<0.05$) after the intervention; the use of risk assessment tools increased also in the control hospital from 61 to 99% ($p<0.05$)	The fall rate per 1000 pt bed days was 1.1 after the intervention compared to 0.6 in the control hospital; fall rates declined from 1.4 per 1000 pt days at the intervention hospital before the intervention to 1.1 after the intervention (n.s.); the falls rates at the control hospital remained at 0.6.

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
Krauss et al. (2008)	CT	4 general medicine floors in an urban, 1300-bed tertiary-care academic hospital	Yes	Acute hospital pts; N: 135 pts (57 pts intervention vs 78 pts control)	Clinical staff, pts	Daily risk assessment (Morse Fall Scale), pt education, modify environment to make it safer, alert signs above bed and/or wrist band, pt / family education, toileting schedule / 2 hour safety rounds, medication review, walking aid, other measures (e.g., bed alarm system, request that family sit with pt); staff education vs usual care (many falls prevention strategies already in place, e.g., daily risk assessment, pt / family education, signs, other measures)	RA, E, ED, S, MF, T, EQ	Significant differences between intervention and control group for bed brakes on, use of wristbands, dot on chart, dot on census board, activity level displayed on board, pt education, toileting schedule maintained, medication discussed, exit alarms	The fall rates were not statistically significantly different between the intervention and control group (p=0.41); the rate of falls in the intervention group dropped from 6.64 falls per 1000 pt days before to 3.81 5 months after the intervention (p=0.04), however, the change did not remain after 9 months of intervention (p=0.31)
Mador et al. (2004)	RCT	2 metropolitan teaching hospitals	No	Medical or surgical pts aged ≥ 60 N: 71 pts(36 intervention vs 35 control)	Nursing staff, pts	Assessment and ongoing individualized advice from an extended practice nurse on non-pharmacological strategies vs usual care	RA, ED	n/a	10 falls in the intervention vs 4 falls in the usual care group (p=0.083)
Meade et al. (2006)	CT	27 nursing units in 14 hospitals	Yes	Hospital pts N: n/a	Nursing staff	2-hour rounding (offering toileting assistance, call light within reach etc.) vs 1-hour rounding vs usual care	R/T	n/a	13 falls in the 2-hour rounding group after intervention vs 19 before (n.s.); 12 falls in the 1-hour rounding group after intervention vs 25 falls before (p=0.01); control group 19 (pre) and

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
									13 (post) falls
Padula et al. (2011)	CT	3 medical-surgical units in an acute care teaching hospital (1 intervention, 2 control)	Yes	Pts who agreed to participate, not on strict bed rest / length of stay ≥ 3 days; in intervention unit cardiac and respiratory diagnoses were common; in control units gastrointestinal, respiratory, and oncology diagnoses were common N: 225 pts in the intervention group (32 beds), control units had 13 and 25 beds	Pts	Targeted lower extremity strengthening exercises and ambulation; Geriatric Friendly Environment through Nursing Evaluation and Specific Interventions for Successful Healing mobility protocol vs ambulation; Geriatric Friendly Environment through Nursing Evaluation and Specific Interventions for Successful Healing mobility protocol without strengthening exercises	E	n/a	In the 6-month study period, the mean fall rate in the intervention group was 3.2 per 1000 patient days and 2.8 and 3.3 in the control units
Raeder et al. (2010)	Cross-sectional survey	28 hospitals answered survey	No	Hospital pts N: 5,046 pts (1369 pts in hospitals without guideline, 2341 pts in hospitals developing a guideline, 1336 pts in hospitals with guideline)	Staff	11 hospitals with implemented falls prevention guideline, vs10 in the process of developing a guideline, vs 7 not using a guideline	n/a	n/a	Fall rate 4.9% in hospitals with guidelines, 4.2% in hospitals without guidelines, 3.6% in hospitals developing a guideline; the multivariate analysis shows that a fall prevention guideline reduced the risk of falls and risk of fall-

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
									related injuries
Schwendimann et al. (2006)	CT	2 nursing units in an acute care teaching hospital	No	Hospital pts, mean age 73 (intervention) and 69 (control) N: 409 pts (198 intervention, 211 control)	Pts, staff, hospital environment	Staff education, risk assessment (Morse Fall Scale), new fall incident reporting system, new care protocol (including identification of pt status , scheduled toileting; safe footwear; exercise; medication review; signs above bed) vs usual care (environmental safety was provided for every pt but not in a systematic manner)	MF, E, RA, ED, R/T, S, AF, EQ	n/a	11.5 falls per 1000 pt days in the intervention unit vs 15.7 in the usual care unit (p=0.342)
Shorr et al. (2010)	Cluster RCT	16 general medical-surgical nursing units in a community hospital	Yes	n/a N: n/a 65,490 pt days in intervention, 142,615 in control group nursing units	Nurse	Proximity alarm systems, daily rounds vs usual care (existing fall prevention protocols)	EQ	Prevalence of alarm use was 64.41 days / 1000 pt days in treatment, 1.79 days / 1000 pt days in control units	The intervention group was not significantly different from the control group regarding the rates of falls (p=0.19) or injurious falls (p=0.96)
Spetz et al. (2007)	CT	A post-neurosurgery unit in an acute care hospital	Yes	Neurosurgical pts N: 567 pts (103 pts in 10 beds intervention, 464 pts, 24 beds control)	Equipment	An electronic pt vigilance system (sensor array measuring pulse and respiration placed under 10 beds, bedside unit connected to nurse call system, bed exist alert) vs usual care (including pt sitters, assisting with ambulation, moving pts closer to nurses' station, bedrails, restraints, other standard	EQ	n/a	2 falls (1.94%) in the intervention vs 15 falls (3.23%) in the control beds

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						practices to prevent falls)			
Stenvall et al. (2007)	RCT	Orthopedic and geriatric wards	No	Pts with femoral neck fractures N: 199 pts (102 intervention vs 97 control)	Staff, pts	Staff education, a dedicated team, routine individual care planning, audit and review, risk assessment, routine Calcium and vitamin D for high risk pts, routine nutrition registration or protein-enriched meals, home visits vs usual care	RA, MF, ED, AF, NM	n/a	6.29 falls per 1000 pt days in the intervention group vs16.28 in the control group (rate ratio 0.38, p=0.006)
Tideiksaar et al. (1993)	RCT	A geriatric evaluation and treatment unit in an acute hospital	Yes	Geriatric pts with poor bed mobility N: 70 pts (35 intervention vs 35 control)	Equipment	Bed alarm system, hourly checks, restraints vs usual care (hourly checks, restraints)	EQ	System was well accepted by pts, family, and staff; nurses responded to 92% of alarms in less than 1 minute	1 fall from bed, 5 falls in total in the intervention vs 4 falls from bed and 12 falls in total in the control group (bed falls p=1.00)
van Gaal et al. (2011)	Cluster RCT	4 internal medicine and 6 surgical wards in 4 hospitals	No	All pts admitted to wards eligible N: 1081 intervention vs 1120 control pts	Staff, pts	Pt safety program including education for nurses (causes, pts at risk, and how to prevent adverse events), pt information (including leaflet how to prevent adverse events such as falls);and computer registry for adverse events, feedback to nurses vs usual care (no specific initiative for falls)	ED, AF	n/a	29 falls per week in the intervention vs 26 in the control wards 1.5 years after intervention start, rate ratio 0.67 (95% CI: 0.17, 2.58)
Historic controls									

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
Amato et al. (2006)	Time series	A stroke rehabilitation unit and brain injury rehabilitation unit in a teaching hospital	Yes	Stroke / brain injury pts, some restrained N: n/a	Nurses	Physical restraint reduction intervention, education, bed exit alarms, surveillance techniques (15 min checks, moving pts) and assessment rounds, weekly consultation rounds and feedback vs before (use of restraints)	ED, R/T, EQ, AF, MF	n/a	Falls rates decreased from 11.4 to 6.1 (average stroke unit, 45.5% relative reduction) and from 9.1 to 3.3 (average brain injury unit, 64.2% reduction)
Barker et al. (1993)	B-A	2 psychiatric units in an acute hospital	Yes	Psychiatric pts N: n/a	Nursing staff	Risk assessment (tool shown), standardized nursing care plan for at risk pts, sticker for chart, pt education, Geri chairs, Posey vests, nursing staff mix modified to meet custodial needs, pts needing supervision clustered, toileting and ambulation schedules, status reports in change of shift report, close observation schedules; Institution-wide falls awareness program, interdisciplinary task force established, committee reporting to senior management group, staff education vs before	RA, E, MF, EQ	n/a	Falls rates decreased from 6.84 to 4.16 per 1000 pt days after 4 year intervention
Barker et al. (2009)	Time series	An acute hospital	No	Hospitalized pts N: n/a	Clinical staff	Risk assessment (tool shown); multidisciplinary committee, education; sign above bed; supervision while in bathroom; low beds; walking aid within reach; scheduled toileting; bed	RA, ED, S, R/T, EQ, MF	Staff compliance with documentation of fall risk scores and interventions	The falls rate varied throughout the observation period (9 years), and no significant change in the rate from pre- to post-

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						and chair alarm vs before		was 70%	intervention was observed
Barrett et al. (2004)	B-A	A district general hospital	No	Hospitalized pts N: n/a	Nursing staff	Education, risk assessment (presumably STRATIFY) vs before	ED, RA	n/a	Slips, trips and falls increased from 2,271 to 2,470. The number of falls-related injuries including fractures was reduced from 710 to 528 after 2–year implementation
Beasley et al. (2009)	Time series	A full-service tertiary community hospital	Yes	Hospitalized pts N: n/a	Pharmacists	Daily medication review by pharmacists, medication fall risk score; recommendations communicated to physicians, evaluation placed in pt chart; care plan specifies use of call light for assistance; pt education vs before (risk assessment tool without medication review)	RA, ED	n/a	The total falls rate decreased from a mean of 4.69 to 1.07 (total fall rate decrease by 30%), the injury fall rate decreased from 2.06 to 1.06 per 1000 pt days after 2-year implementation (48% reduction)
Brandis et al. (1999)	B-A	A 500-bed acute general hospital	No	Hospitalized pts N: 42,389 admissions with 159,989 occupied bed days post-intervention, 37,082 admission with 155,023 occupied bed days before	Staff	Multidisciplinary taskforce established, audits and changes of physical environment, risk assessment (presumably based on Barthel Index plus question 'Have you had a fall in the last 6 months?"), signal system (arm band, bed sign), hip protectors, falls management plan decision tree added to ward manuals, staff education	MF, S, RA, ED	n/a	1.61 falls per 1000 bed days after vs 1.74 before; 4.48 falls per 1000 admissions after vs 5.42 before

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						vs before			
Browne et al. (2004)	B-A	5 hospitals in a health care system	Yes	n/a N: n/a	Clinical staff	A computerized information system (ADAPT Fall Tool) for risk assessment, tailors interventions to specific risks (disorientation precautions, activity precautions, post-medication precautions, toileting precautions), fall risk problems prioritized on care plan, highlighted on multidisciplinary report sheet, part of patient care conferences vs before (modified Hendrich Fall Assessment tool; daily high risk pts report, armbands, signs above bed, sticker in chart; care plan adjustments according to risk, 40 potential interventions to chose from)	RA, MF, AF	100% compliance (assessments integrated into admission and shift assessment documentation)	Fall rates decreased from 3.41 before the intervention to 3.21 per 1, 000 adjusted pt days after the intervention (n.s.). Fall-related injuries per 100 falls decreased from 1.44 to 0.95 (n.s.)
Callahan et al. (2009)	B-A	A hematology-oncology / bone marrow transplant unit	Yes	n/a N: n/a	Nursing staff	Hourly nursing rounds (checking for pain, positioning / comfort, toileting, personal needs, safety), medication review, daily risk assessment (Morse Fall Scale) vs before	AF, RA, R/T	There was increased staff satisfaction	The fall rates with injuries decreased by 100% from 3 during 3 months prior to 0 after the intervention
Cannard et al. (1996)	B-A	A ward in a general hospital for elder pts, respite as well as acute care	No	Elderly pts N: n/a	Clinical staff, pts	Risk assessment (FRASE, tool shown); interventions based on risk assessment (e.g., hazard card over bed and / or use of mobility monitor (Ambularm), pt education, bell at hand, low bed position, frequent checks,	RA, S, ED, EQ, MF	n/a	The number of pts who fell decreased by 15% and the fall incidence decreased by 22% after the intervention

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						appropriate chairs, vs before			
Capan et al. (2007)	B-A	An acute care hospital	Yes	All admitted pts N: n/a	Pts, clinical staff	Risk assessment every 12 h (tool shown, includes Timed Up and Go test); interdisciplinary team rounds to discuss care plans; post-fall review; wrist band; sign on door, pt / family education, hip protector, orthostatic hypotension assessment every 24 h; plus interventions based on risk scores (e.g., bed / chair alarm, delirium assessment, prompted toileting); fall risk and interventions part of change of shift report and interdisciplinary plan of care form; Multi-disciplinary falls prevention task force, root cause analysis, staff involvement in equipment selection, staff education (including self-directed leaning module with test, awareness promoted), unit champion selected vs before	RA, S, ED, EQ, MF	95% of staff completed the education sessions	Fall rate dropped from 0.45 per 100 pt days before intervention to 0.32 after. Severity of fall-related injuries also declined
Carroll et al. (2009)	B-A	An acute care hospital, data for head trauma unit	Yes	Head trauma and neurologically compromised pts N: n/a	Nursing staff	Risk assessment (tool shown); 4 core elements (identification, monitoring, modifying physical environment, pt specific interventions); sign posted on door and assignment board; armband; computer	RA, S, MF, ED, EQ	n/a	The number of falls and falls with injuries increased initially but was then shown to be reduced significantly 3

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						order placed to alert other departments; orders are reflected on printable care plan used for shift reports; clutter eliminated; nursing protocols developed (to choose individual care plans), catalog of interventions (e.g., hourly rounds) ; Fall quality improvement initiative assembled interdisciplinary team; staff education (50 classes for frontline staff) vs before			months after the intervention implementation; a head trauma unit reported a decrease in fall average of 14.18 to 2 falls per 1000 pt days
Cohen et al. (1991)	B-A	A neuroscience unit in an acute hospital	Yes	Neuroscience pts N: n/a	Staff	Risk assessment; sign placed on door, over bed and Kardex flagged; individual care plan depending on mental status documented on form (e.g., pt and family education, hourly rounds, restraints); daily classification (Nursing Productivity and Quality system); staff education; performance audit and feedback vs before	RA, S, R/T, AF, ED, MF	n/a	Fall rates remained ≤ 3.8 per month in 8 out of 12 months within 1 year of implementation; the fall rate was 3.8 before the intervention
Craighead et al. (1991)	B-A	A neurological/ neurosurgical unit in a hospital	No	n/a N: n/a	Nursing staff, equipment, pts	Computer program to collect fall data, a multidisciplinary team, goal setting, risk assessment, new care process, education, audit and feedback vs before	RA, EQ, MF, ED, AF	Questionnaire completed by 90% of unit staff indicated that program was useful	The fall rate initially rose to 10 per 1000 pt days then decreased to 7 (2nd quarter) compared to 9 per 1000 pt days before the

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
									intervention
Croft et al. (1992)	B-A	A 220-bed hospital	Yes	n/a N: n/a	Pts, staff	Risk assessment; stickers on beds, doors, nursing care plans, next to names on patient call system; pt / family education; family alerts nursed when leaving; safety room check (bell within reach, side rails, bathroom light on, bed wheels locked, non-slip socks / slippers, restraints); fall evaluation card when falls occur vs before	RA, S, ED	n/a	Falls decreased by 60% after the intervention
Dacenko-Grawe et al. (2008)	B-A	Acute care 325 bed teaching hospital	Yes	Hospitalized pts (adults and children) N: n/a	Staff, pts	Risk assessment (tool shown) every shift; identification bracelets, symbol placed on door; all staff instructed to monitor and accompany pts to the bathroom or bed; bed exit alarm; non-skid footwear; fall review tool after fall occurred; pt / family education; reminder sign (native language) not to get out of bed in pt room; hourly rounding established in last intervention year vs before	RA, S, EQ	n/a	The falls per 1000 pt days decreased from 4.04 (255 falls) before the implementation to 2.27 (123 falls) after 4 years (p=0.002); the intervention continued to evolve in this period
Dempsey et al. (2004)	B-A	A regional teaching hospital	No	Pts admitted to acute medical wards N: n/a	Nursing staff, pts	Risk assessment, staff and pt education, graphic alerting to 'at risk pts', falls recorded on care plan vs before	RA, S, ED	Compliance with assessment of risk, identification of pts at risk, introduction of	The number of falls was 73 before and 40 after the intervention, a 55% reduction; the rate of falls was reduced from 3.63

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								prevention strategies and documentation averaged 88% (range 69 to 94%)	per 1000 occupied bed days before the intervention to 2.29 after 1 year ($p<0.05$). The falls rate continuously rose to 6.8 per 1000 occupied bed days after 6 years
Diduszyn et al. (2008)	B-A	3 telemetry floors and 1 neurology floor in a 500 bed acute care teaching hospital	Yes	Telemetry and neurology pts N: n/a (24 alarms)	Equipment	Wireless nurse call fall monitor (bed alarm, alarm announces message, e.g., 'please stay in bed' and alerts nurse's beeper); fall report form vs before (existing falls prevention program including bed alarms, sound in pt room only)	EQ	13% of fallers and 16% of high risk pts had used the device	The number of falls decreased by 18% from 78 within 4 months before to 65 falls within 4 months in the same period after the intervention
Donoghue et al. (2005)	Time series	An acute aged care unit in a hospital	No	Elderly pts N: n/a Occupied bed days 3,972 pre- and 3,455 post-intervention	Staff	Volunteer companion observers vs before		n/a	The fall rate decreased from 16.4 per 1000 occupied bed days to 8.8 after ($p<0.000$)
Fonda et al. (2006)	Time series	Aged Care Services wards	No	Elderly pts N: 2,056 pts 2-year post, 1,905 pre-intervention	Staff	Risk assessment (Falls Risk Assessment Scoring System (FRASS)); root-cause analysis; large number of interventions (e.g., non-slip chair mats); staff education vs before	RA, MF, ED, EQ	Survey after first year indicated that 60% of staff had altered their work practices to be more effective in preventing falls, 74% were more aware of	The number of falls per 1000 OBDs was reduced from 12.5 to 10.1 ($p=0.001$) 2 years later. The number of falls resulting in serious injuries per 1000 OBDs was reduced from 0.73

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
								falls prevention issues for their pts	to 0.17 (p< 0.001)
Galbraith et al. (2011)	B-A	An elective orthopedic hospital	No	Primarily pts with elective orthopedic procedures N: 3,364 pts after the intervention vs 3,675 pts before	Nursing staff, pts	A multidisciplinary task force; risk assessment (FRASE); staff, pt / family education; auxiliary nursing station at night for supervision; non-slip mats, hand rails, better lighting; regularly toileting; high risk pts assigned to beds near nursing station; sign placed over bed and in notes, assistance provided with ambulating; training with physiotherapist; commodes and hand held urinals encouraged; audits vs before	ED, RA, MF, AF	n/a	The fall rate decreased significantly from 3.49 per 1000 bed days to 2.68 (p=0.0182), a 30.6% relative risk reduction
Geffre (2006)	B-A	6 medical units (medical, oncology, surgical, telemetry, transitional care, rehabilitation)	Yes	All pts in ward N: n/a	Equipment, nurse	Risk assessment; bed exit alarm vs before	EQ, RA	n/a	The incidence rate of total falls decreased from 2.04% before to 1.52% after the intervention (n.s., 25% decrease), the rate of unassisted falls (no caregiver present) decreased by 38%, but the rate of assisted falls (a caregiver was present and unsuccessfully tried to prevent the fall) went up from

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
									0.11% to 0.32%
Gilbert et al (1999)	B-A	Neuroscience unit, tertiary care university hospital	Yes	Pts in unit N: n/a	Equipment	Restraint reduction program (use of rocking chair, recliner, Ambualarm, mittens); staff education; daily rounds to assist staff in developing care plans vs before (use of physical restraints)	EQ, ED	n/a	The fall rate was 7.84% during the 3 month implementation phase and 8.56% for the 3 months earlier
Giles et al. (2006)	Time series	Major geriatric wards in 2 hospitals	No	Geriatric pts N: n/a 4828 pre-occupied bed days, 5300 post-intervention	Staff	Volunteer program, multidisciplinary team to develop guidance; volunteer education; pts moved to 4-bed safety bay; risk assessment (STRATIFY or clinical judgment) vs before	RA, ED	n/a	14.5 falls per 1000 OBDs (70 falls, 4828 OBD) before compared to 15.5 falls per 1000 OBD (82 falls in 5300 OBDs) during intervention implementation. No falls occurred with volunteers were present
Goodlett et al. (2009)	B-A	A 34-bed internal medicine unit	Yes	Older pts at high risk for falls based on historical data, with cognitive dysfunction or non-adherence to safety instructions N: 417 in camera surveillance room	Equipment, staff	24-hour camera surveillance, monitor observed 24 hours by unlicensed assistive personnel, intervening to prevent falls (going to the bedside, speaking through the call system, alerting other staff, notifying nurses of increased restlessness, agitation or other behavior vs before	EQ	n/a	The mean annual unit fall rate decreased by 6% after implementation, the falls rate in the surveillance rooms was not lower than in the rest of the unit (p=0.548); only 1 fall in 417 pts occurred in the surveillance rooms in 12 months, 0.68 falls per 1000 pt

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
									days
Gowdy et al. (2003)	B-A	A community hospital	Yes	All admitted adults N: n/a	Clinical staff, equipment	Risk assessment (tool shown); interventions stratified by risk listed on tool (e.g., bracelet, colored name card on door, non-slip socks or shoes, remove clutter, consult pharmacist for medication review); reassessment every 12 hours; pt / family education; multidisciplinary team; root cause analysis on each fall, fall cause analysis tool (tool shown): bed exit alarms and motion detectors; assistive walking devices; mirrors enable nurses to supervise the hallways; staff education vs before	RA, S, ED, EQ, RA, MF	n/a	The fall rate decreased from 6.1 before to 2.6 per 1000 pt days after the intervention
Guarascio-Howard (2011)	B-A	A medical-surgical unit with 24 rooms in a hospital	Yes	n/a N: n/a (24 beds)	Equipment, staff	Wireless communication device equipped with display and audio for team communications and alarms, bed exit alarms and bed status changes displayed as text messages with audible notifications; bed alarm protocol; bed protection template stratified by risk (e.g., low bed position, bed exit alarm), education, support system for system failures established; staffing changes vs before (fixed communication audio stations,	EQ, ED	Wireless communicator use was 11%, phone use decreased from 20% to 11%	Average 6-months fall rate decreased from 2.7 to 2 (n.s.) in the intervention period

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						alarms rang at master station, pillow speaker to communicate with pt, caregiver had to see call light or be notified)			
Gutierrez et al. (2008)	B-A	A definitive observation unit in a telemetry setting	Yes	n/a N: n/a	Staff	Multidisciplinary team; staff education; team champion; audit and feedback; fall protocol; high-fall risk order sets; designated area for high risk pts; post-fall order sets; low beds; bed alarms; portable computers for documentation within the sight of pts; risk assessment (Morse); risk score included in nurse report vs before	MF, RA, EQ, AF, ED	>50% of surveyed RNs had experienced a pt fall in the last year but were not communicating the fall-risk level at report or during transfer	Fall rate decreased from 4.87 per 1000 pt days to 3.59 immediately after the intervention and to 1.37 per 1000 pt days 3 months later
Hanger, et al. (1999)	B-A	Assessment, treatment, and rehabilitation wards in an acute hospital	No	All admitted pts N: 1968 (981 after vs 987 before)	Staff	Restricted use of bedrails, education, alternatives encouraged (e.g., scheduled toileting, medication review) vs before	ED, R/T, MF, NM	n/a	191.7 falls per 10,000 bed days after intervention vs 164.8 falls per 10,000 bed days (p=0.18). Serious injuries decreased significantly after the intervention (p=0.008)
Hathaway et al (2001)	B-A	Rural hospital	No	Pt over the age of 65, medical and surgical pts N: 111 after	Staff, equipment, pts	Risk assessment (form shown), 3 risk categories, interventions selected accordingly (e.g., armband, sticker in folder and nursing care plan, moved to central ward with full supervision, non-slip mat, bedrails, movement alarm); staff, pt / family education	ED, EQ, RA, S	n/a	The number of falls decreased from 88 to 61; 34 pts fell at least once after the intervention

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Hendrich (1988)	B-A	A hospital	Yes	n/a N: n/a	Staff, equipment, pts	Risk assessment (Hendrich, tool shown); post-fall form (tool shown), flow sheet to document interventions (wrist bands, symbol above bed and charts, pts placed close to nursing station, assistance with bathroom rounds, bedside commodes, night lights in room and bathroom, low bed, footwear, supervision while out of bed; reassessment every 8 hours; bed exit alarm, pt / family education); staff education vs before (e.g., night lights, rounds, side rails)	RA, S, MF, ED, EQ	n/a	Falls decreased by 50% compared to the same months in the pre-intervention year
Hernandez & Miller (1986)	B-A	A gero-psychiatric unit in a medical center	Yes	Pt over the age of 62 with a psychiatric diagnosis N: n/a	Staff, pts	Risk assessment, three levels of fall precautions and related interventions (e.g. call lights pinned to pt gowns signals bed exit, pt education, regular safety rounds, group high-risk pts together during periods of staff shortage) vs. before	RA, ED	n/a	Before the intervention, pts fell at a rate of 24.98 per 1000 pt days; the fall rate decreased by 42.3% in the 1st intervention year and another 39.4% in the second year; a total decrease of 81.75%
Innes & Turman (1983)	B-A	An acute care, 362-bed hospital	Yes	All admitted pts N: n/a (32 high-risk pts identified)	Staff, pts	St Francis care plan; workshop, staff education; risk assessment (St Francis, tool shown); stickers for doors, call button in nursing station and Kardex; monitor sheets to track preventive measures;	ED, RA, S, ED	n/a	3 falls occurred in a 725 pt day period after the intervention implementation, 6 falls in 730 pt days were recorded

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						poster to encourage pts to call for help; pt / family education vs before (physical restraints, side rails, medication)			previously
Innes (1985)	B-A	An acute care hospital	Yes	n/a N: n/a	Staff	Annual multidisciplinary workshop, bi-monthly performance review, periodic staff education; risk assessment (St Francis, tool shown); stickers for doors, nursing call buttons and Kardex; poster to encourage pts to call for help; pt / family education; ambualarm vs before (stickers for doors, nursing call buttons and Kardex; poster to encourage pts to call for help; pt / family education)	MF, ED, RA, AF	n/a	The number of falls was reduced 44% after 1 year and the ratio of falls to pt days decreased 37.5%
Ireland et al. (2010)	B-A	60 clinical units in a hospital	No	n/a N: n/a	Clinical staff and pts	Systems change, staff engagement, expert consultation, policy and protocols, staff and pt education, marketing, and celebration to design; risk assessment (3 question screen for all (questions reported), more as required); education vs before	RA, MF, ED, RA, AF	92% of clinical staff participated in the education; 13% improvement in documentation of fall risk	Fall rates per 1000 pt days decreased by 20% after 1-year implementation
Karius et al. (2006)	B-A	Inpt oncology unit	Yes	Oncology pts N: n/a	Clinical staff, pts	Risk assessment (Hendrich II Fall Risk); pt and family education including posters in pt rooms and leaflet in admission packet; daily	E, ED, RA, MF	n/a	The number of falls decreased from 48 before to 37 after the intervention and

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						pharmacy reviews of medication profiles; physical therapy department reviews fall risk documentation; collaborative prevention strategies, multi-disciplinary team vs before (different risk assessment tool)			remained stable the following year. No severe fall related injury happened after the intervention
Kolin et al. (2010)	Time series	Rural medical center within health care system with acute care facilities	Yes	n/a N: n/a	Staff, equipment, pts	Risk assessment (tool shown); basic safety interventions (bed locked, in low position, call bell in reach); post-fall form with mini-root cause analysis (tool shown); Patient and family education brochure and DVD; medium risk: basic safety interventions plus arm band; rounds with checklist; bed alarms based on clinical judgment; high risk: plus mandatory bed alarms and appropriate room location vs before (different risk assessment tools)	RA, MF, AF, ED, EQ	System data show promising results with the complete implementation of the new program	In one medical center, falls decreased from 21 to 5 per month after 6 months of intervention; previously 174 falls and 3 falls with injury. Injury rate of 1.7 reduced to an average fall rate per 1000 pt days of 2% and 0 injury rate per 10,0000 pt days in the 3 months after the intervention
Kratz (2008)	B-A	Medical-surgical unit in a medical center	Yes	Elderly pts N: n/a	Pts, staff	Acute confusion protocol with interventions aiming at orientation (e.g. use reminiscence), non-pharmacologic sleep (e.g., use soft music), and early mobilization (e.g., use toileting schedules); pharmacist send alerts for medications on Beers list, standard order set revised,	ED, MF	n/a	Pt fall rate decreased from 4.8 per 1000 pt days to 3.6 per 1000 pt days; decrease has been maintained for 3 years

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						RNs suggest alternatives when noticing listed medications vs before			
Lancaster et al. (2007)	B-A	9 hospitals in a health system	Yes	n/a N: n/a	Clinical staff, equipment, pts	Risk assessment (Hendrich II Fall Risk); visual identification; communication of risk status; pt, families and staff education; specific interventions (e.g. sign on door, non-skid slipper socks, sticker on chart) varied by site; multidisciplinary team vs before	RA, ED, MF, EQ	~ 80% of hospitals joined voluntary falls affinity group and participated in meetings and monthly conference calls to learn from each other	Acute fall rates were reduced 9.9% after intervention
Lane et al. (1999)	B-A	Medical-surgical /critical care units in a community hospital	Yes	Medical-surgical / critical care pts N: before n/a, after: 292 pts	Clinical staff	Risk assessment (factors reported); new care guideline vs before	RA	Fall risk assessment completed during admission process for all pts	Fall rates increased from 2.27 per 1000 pt days (412 falls / 181,876 patient days) before intervention to 3.89 after (373 falls / 95,867 patient days)
Lee et al (2002)	B-A	48 wards and the accident and emergency department in a 1,400-bed acute care hospital	No	Pt with a history of falling N: n/a	Staff, pts	Joanna Briggs Institute Falls in Hospitals guideline implemented (assessment and reassessment of risk of falling, implementation of a formal fall prevention program using multiple interventions, increasing staff and pt awareness of fall risk factors and potential prevention strategies, evaluation of the effectiveness of the	ED, MF	Before, 69% of fallers had preventive measures in place, compared to 75% of fallers after implementation	16 pt fell before, 12 pt after the guideline implementation

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						implemented interventions and development of needed modifications); staff education vs before			
Lieu et al. (1997)	B-A	A 28-bed geriatric ward	No	Geriatric pts N: 770 pts before; 831 pts after 1 year; 505 pts after 2 years	Nursing staff	Risk assessment (factors reported), education, new care protocol vs before	RA	n/a	The fall rate decreased from 6.85 per 1000 patient days to 6.07 after 1 year (n.s.) and 2.94 after 2 years (p=0.04)
Llewellyn et al. (1988)	B-A	An acute cardio-vascular surgery unit in a medical center	Yes	Surgical pts N: n/a (before: 220 fall incidences, after: 130 pts fell)	Staff	Risk assessment (tool shown); education; interventions selected based on assessment (sticker, environment check at end of shift, blood pressure check at admission, scheduled toileting, side rails, rounding, no sleeping medications, call light pinned to gown, restraints), reinforce interventions during shift report; fall review, vs before	ED, RA, AF, S, R/T	n/a	The rate of falls increased from 3.4 to 4.4 per month in the 1st year and 3.8 per month in the 2nd year of implementation
McCollam et al. (1995)	B-A	40-bed cardiology general medicine unit in a VA hospital	Yes	Pts admitted to cardiology – general medicine unit N: before: n/a, after: 458 pts	Clinical staff	Daily risk assessment (Morse Fall Scale); education; interventions based on assessment vs before	RA, ED	Follow-up monitoring of compliance with instrument completion on admission ranged from 75-85% in the 18 months after introducing;	Before the intervention, there were 186 falls and 11 related serious injuries. After, there were 245 falls and 4 serious injuries

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
								high risk interventions only present in 50–58%	
McKinley et al. (2007)	Time series	A regional hospital	No	All hospitalized pts N: n/a	Clinical staff, equipment	Multidisciplinary team; audit and feedback; risk assessment (n/a); interventions include risk alert in medical record; medication review, new beds and chairs; bed alarm; additional rails in bathroom; staff awareness training vs before	AF, EQ, RA, MF	n/a	Percentage inpatient falls per bed day (monthly) reduced from before 0.82% to 0.33% after 1 year and 0.3% after 2 years (percentage rates derived from number of falls V overnight bed days per month)
Meissner et al. (1988)	B-A	A medical, 35 bed unit in a hospital	Yes	n/a N: n/a (35 beds)	Nurses	Risk assessment, staff education; written care protocol; interventions depend on assessment (e.g. bed alarm; hourly safety assessments; signs on door and intercom panel; restraints; sitters) vs before	RA, S, ED, EQ, R/T	n/a	The rate of falls with related injuries decreased by 100% after the intervention (from 10 to 0 falls 6 months post-intervention)
Mercer (1997)	B-A	A 111 bed community-based hospital	No	n/a	Staff, pts	Risk assessment (tool shown), daily assessment and at admission; risk scores translate to 3 risk management strategies including placing bell within reach, pt and family education, regular rounds, medication review, low bed position, restraints; falls incident form vs before	RA, ED, R/T	100% compliance for call bell within reach	The rate of falls as a percentage of total separations or discharges was 1.55% before the intervention and 1.10% in the 1st and 0.88% in the 2nd intervention year; there was a reduction of 26.75% in the total

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
									number of falls after implementation and a further reduction of 10.43% 1 year later
Miller et al. (2008)	B-A	A leukemia-lymphoma unit in a hospital	Yes	Pts with cancer n/a	Nursing staff	Staff education, hourly rounding (including toileting, pain assessment); existing interventions (sign on door (sign shown), identification bracelet, pt education, checklist with nursing interventions (e.g. use of bed exit alarm), high-risk medications and alternatives listed); audit and feedback of rounds vs before (existing fall prevention packet)	B-A, ED, MF, S, R/T	n/a	The intervention reduced the average fall rate from 4.88 per 1000 pt days to 3.28. The injurious fall rate decreased from 1.2 per 1000 pt days to 0.94
Mion et al (2001)	B-A	2 medical, 1 neurological and 1 surgical unit of an urban academic medical center (1000 beds acute care hospital)	Yes	Pts in physical restraints, pts who had sustained a fall or were considered at risk of falling, or pts disrupting their therapy (or at risk of) N: before: n/a, after: 840 pts	Staff, pts	Restraint reduction program (administrative, educational, consultative, and feedback component); falls prevention strategies (e.g. increased surveillance by moving pt to room within view of nurses' desk, toileting schedule); delirium assessment, prevention and management strategies, anchoring / securing therapeutic devices; daily audit and feedback on strategies; interdisciplinary rounds; case conferences; fall rates	MF, AF, ED, T	n/a	In the same time period, the 2 medical, neurological, and surgical units had falls rates of 0.2, 0.3, 0.4, and 0.3 per 100 pt days before the intervention, all units were reduced to 0.1 after the implementation

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						presented monthly vs before			
Mitchell et al. (1996)	B-A	An acute and subacute adult medical ward	No	All pts, mean age before: 76.23 (SD 10.66), after: 72.1 (SD 8.04) n/a	Staff	Risk assessment (tool shown), alert signals (orange dot above bed, assessment form, wrist band etc.), reinforcing preventive actions, staff education, audit and feedback vs before (different risk assessment tool)	MF, S, RA, ED, AF	n/a	4.42 falls per 1000 bed days after vs 7.76 before (p=0.06)
Morton et al. (1998)	B-A	A 42-bed unit in a hospital	Yes	n/a N: n/a	Equipment, staff, pts	Risk assessment (factors reported); high-risk note on admission sheet, Kardex, nursing notes, intercom console; sticker on pt chart; sign near door; frequent checkups; bed rails; call light within reach; low bed position; supervised while out of bed or special equipment; non-skid footwear; bedside commode; nightlight; pt and family education; fall risk part of shift report; bed alarm (Bedcheck) vs before	RA, S, EQ	n/a	The fall rate dropped 25% in the 1st year, 8% in the second year; after introducing the bed alarm, falls were reduced 47% after 1st year implementation and 60% after 2nd year. Recurrent falls dropped 29% after 2 years
Mosley et al. (1998)	B-A	A VA hospital	Yes	n/a N: n/a	Nursing staff, pts	Education, initial assessment then risk assessment (Fall Assessment Form, Berryman), Risk assessment (Fall Assessment Form, Berryman), reassessment after changes / every month; risk and interventions noted on plan of care; several interventions (e.g.	ED, RA, MF	All 16 fallers were correctly identified as at risk and prevention protocol had been implemented	Mean fall rates decreased from 7.07 before to 6.33 after (p<0.003); 6 months after the study an additional 35% decrease in the number of falls was observed

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						sticker on chart, bed, nursing care plan, identification bracelet; pt and family education; low bed; bed rails, close supervision, nonskid footwear, clear paths, encourage buddy system, medication assessment vs before			
Neiman et al. (2011)	Time series	A pediatric hospital	Yes	Children N: n/a	Clinical staff, family	Risk assessment (I'M SAFE Fall Risk Assessment Tool, tool shown) every shift; high-risk interventions for all intensive care units and children < 2 years; staff and family education; low bed; side rails; bed brakes on, clutter minimized; interventions based on risk (medium: assisting with activities, periodic assessment of elimination needs; periodic call light orientation; high: observation, assistance when out of bed; sign at bedside) vs before	RA, MF, ED	n/a	Intrinsic fall rates declined significantly from 0.67 per 1000 pt days before intervention to 0.51 per 1000 pt days (p=0.015)
O'Connell et al. (2011)	B-A	2 wards in an acute care hospital	No	n/a N: 1065 pts (485 after vs 580 before)	Nursing staff	A multidisciplinary team, risk assessment (Morse Fall Scale); new care plan based on risk, interventions listed on nursing care plan (e.g., assistance with transfers at all times, walking aids and call bell within easy reach); sign above beds and on patient allocation board in	RA, S	n/a	The fall rate rose from 12.05 falls per 1000 pt bed days before intervention to 13.22 after (n.s.)

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						nursing station, wristbands vs before			
Oliver et al. (2002)	B-A	An elderly medical unit	No	n/a N: before: 211 pts, after: 175 pts	Staff	Risk assessment (STRATIFY), tailored nursing, medical checklist, stickers in pts notes, feedback vs before	RA, S, MF, AF	Only 64% of STRATIFY scores were completed, 68% of nursing checklists of high-risk patients, and 22% of medical checklists for high-risk pts	13.8 falls per 1000 bed days after intervention vs 11.1 before (p=0.015)
Patient Safety First (2009), p. 17-19	Time series	NHS Trust	No	n/a (care pathway targets pts with a history of falls admitted with unsafe mobility) N: n/a	Staff	Integrated care pathway; sensor panel systems, low rise height bed frames; reporting system modified (additional risk factor questions, feed automatically into training); action plans developed, monitored and evaluated based on falls statistics vs before	MF, EQ, AF	n/a	Reduction in falls from 8.1 to 5.25 falls per 1000 bed days (app. 19 months)
Peterson et al. (2005)	2 inter-vention (after) and 2 control periods (before)	The general ward and intensive care patients in an acute care hospital	Yes	Geriatric pts N: 3718 pts (1793 intervention vs 1925 control)	Equipment / physicians	Medication decision support tool (adapts dose for elderly pts, suggests alternative psychotropic medication) vs before (usual computerized order entry)	MN	Prescriptions agreed more often with recommendations (p<0.001)	Patients in the intervention cohort had a lower in-hospital fall rate (0.28 vs 0.64 falls per 100 pt days; p=0.001)
Quigley et al. (2009)	Time series	2 units (general medicine and oncology;	Yes	n/a N: n/a (34 bed, 21 beds)	Nursing staff, pts	Risk assessment (factors reported); post-fall safety huddles (staff, pt and family); comfort care and safety	RA, S, ED, T/R, EQ	62% of pts were able to teach back fall risk factors, all	The fall rates slightly decreased after the intervention (3.62.

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
		medical-surgical and respiratory care), 34-bed and 21-beds, in VA hospital				rounds; pt education (teach back method); toileting prior to pain medication; pts with risk factors placed on high-risk precautions (e.g., moving pt close to nurse station, chair / bed alarm, hourly rounds, nonskid socks, wristbands and other visual identifiers); injury risk prevention (e.g., hip protectors) vs before		pts were able to teach back benefits of asking for help and to demonstrate how to call the nurse; pts continued to get up to go to the bathroom despite the toileting intervention	to 2.78). The fall related injuries remained stable
Rainville et al. (1984)	B-A	Medical surgical units in a short-term care facility	Yes	n/a N: average daily census 109.3 pts before, average daily census 118.5 after	Nurses, pts	St Francis care plan implemented, care plan lists interventions (tool shown); risk assessment (factors reported) within 24 hours of admission, repeated weekly; pt and family education; environment (bed rails, low bed, call light within reach, room light, nonskid footwear, assisting in voiding every 4 hours); staff awareness (care plan kept with Kardex, sign over bed) vs before (inconsistent risk assessment, restraints, medication, relocation closer to nurse station, family sitter)	RA, ED, EQ, S, R/T	n/a	26 falls (average daily census 109.3 pts) before versus 27 falls (average daily census 118.5) after intervention implementation; in pilot unit, falls decreased by 10% after the intervention with a 4% increase in pts days (from 3351 to 3488)
Rauch et al. (2009)	B-A	A unit in an academic medical center	Yes	Large population of fall-risk pts in unit N: n/a	Clinical staff	Risk assessment (Schmid Fall Risk Assessment Tool); pt and staff education; interventions listed on back of risk assessment tool (pocket card),	MF, S, RA, ED, EQ	The program was well received by staff	The rate of falls with injury decreased from 43 to 14% after the intervention

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						stratified by risk (e.g., visual identifiers [stickers on doors, white board in nurse station, pt bracelet], documentation [electronic chart], pharmacy evaluation of medications); list of at risk pts printed daily; rounding sheet for documentation of at risk pts; post-fall protocol; audit and feedback during rollout, unit team champion identified vs before (existing policy, no risk assessment tool)			
Ruckstuhl et al. (1991)	B-A	A 1,145 bed acute care medical center	Yes	Hospitalized pts N: n/a	Nursing staff	Risk assessment (tool shown); low bed, call light within reach, calls need to be answered promptly, assistive devices within reach, skid proof footwear; eliminate hazards, educate about roll table, pt orientation to surrounding; interventions stratified by risk level (level II: side rails, instruct pt and family to ask for assistance; all items within reach; level III: night light; reorientation; observation; assistance; restraints; sitter) vs before (existing protocol, tool with 5 levels of risk, reassessment every shift)	RA, R/T	n/a	Falls resulting in fractures decreased by 33% after 1 year and 89% after 2 years of implementation
Sahota et al. (2009)	B-A	An ortho-geriatric	No	Pts recovering from acute hip	Equipment	Fall monitoring system (bedside chair and bed	EQ	n/a	The mean number of falls per pt

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
		rehabilitation ward in a hospital		fracture; N: 153 pts after vs 209 pts before		pressure sensor) vs before			decreased from 0.14 before to 0.09 after the intervention (p=0.032); the percentage of fallers decreased from 14.9 to 8.2% (OR 0.55, 95% CI: 0.32, 0.94)
Schmid et al. (1990)	B-A	A 700 bed government-owned medical center	Yes	All pts in 4 nursing units with high fall rate N: before: 334 pts, after: n/a	Nursing staff	Risk assessment (Schmid Fall Risk Assessment Tool, tool shown) at admission, then weekly or after status changes; new nursing care plan, interventions based on risk; signs over bed and outside room; staff is asked to notify nurses in unsafe situations; form to document precautions; more bed alarms; safety vests; falls documented in incidence reports; falls per month monitored; nursing staff education vs before	RA, ED, AF, S, EQ	n/a	Within 3 months after the program, the fall per patient day ratio dropped to 27 from 50 falls per 10,000 pt days (54% decline), data fluctuate; 1 year after the implementation the reduced incidence of pt falls is maintained (41 falls / 10,000 pt days in 4 months); in the 12 months following the institution of the falls prevention program, rates of monthly falls per pt day have averaged 20% lower than peak levels previously
Schwendima	Time	Departments	No	Pts hospitalized	Clinica	Risk assessment (factors	RA, E,	n/a	There was a slight

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
nn et al. (2006)	series	of internal medicine, geriatrics, and surgery in an urban public hospital		≥ 24 hours N: 34,972 pts	l staff	reported), interventions based on risk (e.g., low bed; nightlight; scheduled toileting; side rails; hip protectors), audit and feedback vs before (e.g., older safety vests, fewer alarms)	EQ, R/T, MF, AF		decrease from 8.9 to 7.8 falls per 1000 pt days directly after the intervention (p=0.086). The fall rate fluctuated over a 4-year period
Semin-Goossens et al. (2003)	Time series	2 wards (department of internal medicine and neurology ward) in a teaching hospital	No	n/a N: 2670 pts (from the pilot period to the end of the implementation); two 32-bed wards	Nurses	Grol's 5-step implementation model, multidisciplinary team, risk assessment (factors shown), interventions based on risk (e.g., , education poster; structured environment / family sitters; restraint belt; additional observation rounds); simpler incidence report form vs before	MF, R/T, RA, ED, AF	Incident report forms filled in 52 and 60% on average in the 2 units	In the intervention year, the average fall incidence per 1000 pt days decreased from 9 to 8 (n.s.) and 16 to 13 (n.s.). No sustained decrease in monthly falls was observed after implementation in both of the wards (1.5 years post-intervention)
Stuart et al. (2010)	B-A	A neuro / stroke unit in an academic medical center	Yes	n/a N: n/a	Clinical staff	Rescheduled routines so staff is available at high risk periods; assessment rounds; reference cards for float personnel, warning signs, pt care standards vs before	RA, S, R/T, MF	n/a	The average monthly fall rate decreased from 2.91 before to 1.67 during the 90 day intervention period
Szumlas et al. (2004)	Time series	A tertiary care academic medical center	Yes	All conscious pts N: n/a	Clinical staff	Computerized risk assessment tool, every 24 hours (tool shown); orientation to room, call light, falls prevention; low bed, wheels locked; clutter and spill free room; items within	RA, ED, MF, AF	n/a	20% reduction in total falls achieved after the intervention (p<0.0001); 15% reduction in

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						reach; adequate lighting; pt and family education (verbal and written material); documentation of education; unit level fall reporting; sign on door (with intervention reminder); staff must remain with pt when assisted to bathroom; toileting assistance offered or hourly bedpan; physical and occupational therapy consultation and discharge planning; hourly rounds; sitter if necessary vs before (existing program including educational material for pts, staff education, catalog of 36 interventions)			average fall rate per 1000 pt days ($p<0.0001$); average days between falls with injury more than doubled, sustained through first 11 months following implementation
Tuffnell et al. (1990)	B-A	A general hospital	No	n/a N: n/a	Staff	Risk assessment (factors reported), review and audit, and a multidisciplinary team vs before	MF, RA, AF	Audits of the hospital-wide pt safety standard showed 75% compliance before and 88% after	Falls rates per 1000 pt days decreased from 7.15 (245 falls) in the six months before the intervention (August to January) to 4.46 falls per 1000 patient days (148 falls) in the six months after the intervention (February to July)
Tung et al. (2009)	B-A	An observational unit of a	No	Children; N: 5,225 pts after vs 6,232 pts	Pts, nurse	Alert posters; family education; bedrails; risk assessment (factors reported);	ED, AF, RA	n/a	The rates of children falling off the bed decreased

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
		pediatric emergency department		before		audit and feedback, vs before			from 0.21% to 0% after the intervention ($p<0.001$)
Tzeng et al. (2008)	B-A	2 acute adult medical units in a hospital	Yes	n/a N: n/a	Nurses	Patient Attendant Assessment Tool (assessment of pts' needs for sitters, tool shown), sitters, restraints, side rails vs before (sitters, restraints, side rails)	n/a	n/a	The mean fall rate per 1000 pt days decreased from 4.75 (SD 0.74) to 4.35 (SD 0.51) in one unit and from 5.13 (SD 1.02) to 4.15 (SD 0.83). The injuries from falls per 1000 pt days increased from a mean of 0.25 (SD 0.25) to 0.59 (SD 0.18) and 0.49 (SD 0.68) to 0.58 (SD 0.83) in the 2 units
von Renteln-Kruse et al. (2007)	B-A	Geriatric ward of an academic teaching hospital	No	Geriatric pts; N: 2,981 pts after intervention (57,115 hospital days) vs 4,272 pts before (89,222 hospital days)	Staff	Supervision with mobility and toilet use, staff education, pt information, support with footwear, eyeglasses and mobility aids; fall reassessment (STRATIFY) vs before	MF, EQ, ED, R/T	n/a	893 falls before and 468 falls after the intervention (incidence rate ration 0.82, 95% CI: 0.73, 0.92; $p<0.001$); the rate of falls per 1000 hospital days decreased from 10.0 to 8.2 ($p<0.001$). No significant reduction in total number of injurious falls.

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
Ward et al. (2004)	B-A	A transitional care unit in an acute care facility	Yes	n/a N: n/a	Pts, nursing staff	Risk assessment (factors reported); reminder signs for pts to ask for assistance when getting out of bed; pt and family education (including flyer); reports on new admissions include fall history; fall risk included in shift-to-shift report; monthly falls documented in staff room; shift reports during walking rounds; post-fall review with tool and with family conference; guardian program (badge indicates who is looking after the pt, sitter); bed alarm; scheduled toileting ; safety plan after fall posted near bed vs before	MF, R/T, ED, RA, AF, E	Some falls occurred because new staff were unaware of the program	The fall index (number of pt falls per month divided by total pt days multiplied by 1000) decreased by 54% from 9.32 before intervention to 4.28 after 1 year (same quarter compared)
Wayland et al. (2010)	B-A	A community hospital	Yes	n/a N: n/a	Nursing staff	Risk assessment (Hendrich II Fall Risk); walking reports at change of shift; posters; documentation of pt and family education; fall risk ranking evaluated biweekly; post-fall review; existing interventions plus toileting rounds; reminder sign in room to call for assistance; audit and feedback vs before (Hendrich II Fall Risk tool; interventions chosen according to risk level; interventions ranging from	MF, S, T/R, ED, RA, AF, MF	n/a	The fall rates decreased from 4.37 per 1000 pt days before to 1.29 after 1 month and 0 after 2 months of implementation

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
						sign on door to full-time sitter)			
Weinberg et al. (2011)	Time series	A tertiary care teaching hospital	Yes	Hospitalized pts N: n/a	Clinical staff	Risk assessment (tool shown) but nurses can override scores; post-fall review with documentation of circumstances and future measures including root cause analysis; pt and family orientation; medication adjustments after falls, restricted use of sleeping aids; bed and chair alarms; scheduled toileting with documentation; audit and feedback, education vs before (existing fall prevention program but low compliance)	AF, ED, MF, RA, MF, EQ	n/a	Fall rates decreased 63.9% ($p<0.0001$). Minor and moderate fall related injuries decreased by 54.4% and 64.0%, respectively
Widder et al. (1985)	B-A	Orthopedic and general medical units in an acute care hospital	Yes	Hospitalized pts N: n/a (8 pts received device)	Equipment	Risk assessment (factors reported);bed alarm (Ambularm) secured above the knee of pt vs before	(RA), EQ	n/a	Falls decreased by 45% in the general unit and 33% in the orthopedic unit
Williams et al. (2007)	B-A	3 medical wards and a geriatric evaluation management unit in a tertiary teaching hospital	No	n/a N: before: n/a, 1357 pts after the intervention	Clinical staff	Risk assessment (adaptation of the Queensland Government Health and Safety & Quality Council's tool, factors reported), new care protocol, education vs before	RA, MF, ED	Nurse assessed 98% of eligible pts	The incidence of falls decreased from 9.5 per 1000 OBD to 8 after the intervention ($p<0.001$, same month compared)
Wright et al. (2006)	B-A	A neuro-surgical unit	No	n/a N: n/a	Nursing staff	A multidisciplinary team, a designated room for high risk	MF, EQ,	Compliance with falls risk	The number of falls decreased

ID	Study Design	Setting	US	Patients, N	Target	Intervention Components vs Comparator	Categories	Fidelity	Falls Results as reported (follow-up length)
		in a tertiary referral hospital				pts, sitter, audit and feedback, risk assessment (Mercer fall risk assessment tool), education vs before	AF, RA, ED	assessments, application of wristbands and documentation of risk scores in pt notes was 100%	from 6.5 per month before to 1 per month after the intervention and 0 after 9 months
Zepp et al. (1991)	B-A	A hospital and medical center	Yes	n/a N: n/a	Nurses	Risk assessment, sign on door (sign shown), sticker on chart and Kardex; interventions as necessary including placement in room close to nurses' station, use of sitter; daily reevaluation; audit and feedback; awareness program vs before	RA, S, MF, A	n/a	55% decrease in falls in the pilot units compared to 16% increase in falls in other units; the number of falls dropped 50% after 1-year implementation and a further 39% after the 2nd year

Note: B-A: Before-After study; CT: nonrandomized controlled trial; RCT: randomized controlled trial; n/a: not available, not reported; n.s.: not statistically significant; pts: patients; OBD: occupied bed days; vs: versus; Category: E: Exercise; EQ: Equipment, RA: interventions to identify high risk patients, MF: multifaceted organizational protocols, ED: education, AF: audit and feedback; NM: Nutrition / medication; S: Signal / identification of high risk pts, R/T: Rounds and/or scheduled toileting

Results

The search identified 114 published fall prevention intervention evaluations meeting the inclusion criteria. Table 1 documents the 102 interventions implemented and evaluated in acute care hospital settings.

Study characteristics

The 102 studies documented in Table 1 were published over a period of 30 years. In the evidence table we differentiated between studies with concurrent controls, such as RCTs, and studies with historic controls (before-after studies, time series). Fifteen randomized controlled trials (RCTs) and 10 non-randomized studies reporting results on an intervention and a concurrent control group were identified. RCTs either randomized at the patient level or were cluster RCTs randomizing hospital wards or entire hospitals to the intervention or the control group. The search identified 77 studies evaluating the success of interventions by comparing the number of falls or falls rates to a historic period prior to the intervention implementation. The identified historic-control studies included 14 time series (defined as studies reporting on three or more time points before and after the intervention implementation).

Studies varied in the reach and penetration of the intervention; most studies only targeted selected hospital wards or units. Some studies evaluated interventions in more than one hospital. Consequently, the number of included patients varied widely, ranging from fewer than 50 to over 10,000 eligible patients per study.

Only 11 concurrent control studies evaluated interventions in a US setting; all other concurrent studies came from the international literature. There were a number of historic-control US studies included in the overview (48 studies) but all other documented interventions were evaluated in international settings. Practitioners have to evaluate carefully whether shown interventions are applicable in a US setting.

Studies often took place in geriatrics wards, where falls are a major concern. Thus, in those settings, fall risk assessments may be more commonly undertaken as part of geriatric care approaches and applied to all patients admitted to the ward. Other interventions were implemented in entire hospitals, where a decision tree might determine who should be assessed for fall risk. Some studies used fall risk assessment scales to select patients for the research study and assigned only high-risk patients to the intervention and the control group. In clinical practice, individual hospitals will have to balance the desire to reduce falls with the need to conserve resources by carefully evaluating which intervention components are appropriate and likely to be cost-effective for their individual situation. In addition, selected approaches may need to vary across wards.

Interventions

We extracted intervention components, and, where reported, information on the adherence to the intervention, to allow a comprehensive overview of the included studies.

Interventions varied regarding whether they primarily targeted patients, healthcare providers, safety equipment, or all aspects equally. Most interventions targeted healthcare provider behavior (e.g., introducing a new risk assessment approach), followed by equipment additions

(e.g., bed exit alarms). In addition, several interventions were aimed at specific healthcare providers, most commonly nurses, while other studies introduced multi-disciplinary approaches.

Almost all identified interventions were multi-component in nature. The most common components were risk assessment to determine the individual falls risk of the patient and education for staff and patients and/or families. Among studies that included risk assessment, nearly all developed their own risk assessment tool; few provided information on the reliability or validity of the tool (see table 2). Validated published tools used in more than one included study were the Morse Fall Scale, STRATIFY, and the Hendrich II Fall Risk assessment tool. A few studies tested specific equipment such as low beds (e.g., Haines et al., 2010), bed alarms (e.g., Tideiksaar et al., 1993), or carpet versus vinyl flooring (e.g., Donald et al., 2000). Equipment tested in older studies is often part of the standard falls prevention repertoire in newer studies. Several studies introduced frequent and regular scheduled nursing rounds, often together with an explicit toileting schedule for patients (e.g., Callahan et al., 2009). Several of the included studies also implemented various means of signaling patient risk: signs attached to the rooms, beds, or directly on the patient in the form of wrist bands. Interventions varied in their considerations for patient dignity, an important concern in patient care; some intervention took care to use subtle symbols whose meaning was obvious only to staff members.

Approaches differed in their intervention complexity and organizational implications. Intervention complexity refers to the number of different components or elements included in an intervention or the numbers of different participants involved (for example, a single component intervention would be changing the floor covering on a ward, but most interventions included a falls risk assessment followed by any one or more of a variety of measures, such as reviewing use of medications, increased rounding, and changes in toileting practices). Organizational implications refer to the numbers of care process changes, the degree of participation required from various members of the health care teams, and the extent of changes needed in the built environment. While some studies addressed falls prevention with specific equipment changes (e.g., introduction of low beds), most others changed the care protocol for patients, resulting in organizational structure and process changes. In practice, decision algorithms determining which patients should be assigned to limited resources (e.g., special fall risk room) might need to be established.

Studies compared the intervention effects to usual care results (either with concurrent or historic controls); however, few studies specified what usual care entailed. Some studies documented that there were already a large number of fall prevention tools and interventions in place apart from the experimental intervention (e.g., Krauss et al., 2008) and it has to be suspected that settings varied greatly in the general approach to falls prevention in place prior to the intervention.

Outcomes and results

Achieved improvements varied across studies. Most interventions were unique and targeted towards a specific need of an individual hospital. The settings and patient populations varied widely across studies, hindering evaluation of the comparative effectiveness of interventions. Where reported, the variability in rates of falls across studies was considerable. Achieved post-intervention improvements in one study may have brought fall rates down to the pre-intervention level for another hospital or hospital unit that undertook an improvement program. Throughout,

improvements have to be seen relative to the status before the intervention or the control group in the specific setting and patient population.

Before-after studies were included in this review if they reported numerical data to describe the intervention results. However, some studies reported only on the achieved reduction in falls and did not report on the fall rate before and after the intervention. Falls rates might have been unusually high before the intervention (statistical fluctuation, unusual circumstances), potentially diminishing the actual and comparative success of the intervention. The generalizability of results might be limited and the reduction might be better explained by statistical regression to the mean. In addition, not all identified before-after studies reported falls rates, but instead reported on the total number of falls before and after the intervention without presenting a denominator (e.g., number of patients, per 1000 patient days), thereby limiting the informational value. The number of falls, presented with or without denominator, was the most common measure in the included studies. Only selected studies reported on the number of patients who fell, an informative measure because the same patient might fall more than once so the number of falls is not independent from the number of patients who fell; the number of falls does not distinguish between 100 patients falling 1 time each and 1 patient falling 100 times.

Selected studies with historic controls explicitly compared similar periods of time (e.g., identical quarters in different years); however the majority of before-after studies reported a one-time snap-shot before and after the introduction of the intervention. Several studies provided no information on the periods of time for which falls data were compared. The majority of included studies did not report a test of statistical significance, indicating whether the demonstrated changes were statistically significant. Rare events pose particular problems for the evaluation of improvement. Very few studies reported on an alternative measure to the number of falls (a rare event with problematic statistical properties)—such as the span of time between inpatient falls (a continuous measure with different statistical properties) in addition to the number of falls (e.g., Szumlas et al., 2004).

Studies reporting multiple data points sometimes demonstrated an initial increase in reported falls before falls rates decreased (e.g., Carroll et al., 2009; Lancaster et al., 2007). Some time series demonstrated the fluctuation of falls events over a period of time (independent from falls prevention initiatives), making it difficult to detect an intervention effect (e.g., Schwendimann et al., 2006). Most studies reported data collected in the first months immediately after the intervention. Very few studies reported long-term effects of the interventions and evidence for sustainability of success is sparse. Some studies highlighted that falls rates rose again after initial success; Dempsey et al. (2004) indicated that the rate of patient falls was initially statistically significantly reduced from 3.63 per 1000 occupied bed days before intervention to 2.29 per 1000 occupied bed days after one year, but the falls rate continuously rose thereafter and increased to 6.8 after six years.

Successful approaches

We have identified a large number of approaches that were described as successful and documented in the above evidence table. It should be noted that generally, the studies reported a

reduction in the number of patient falls rather than the complete elimination of falls. Several authors concluded that it is not possible to prevent all falls in acute care facilities.

Given the complex, multi-component, and context-specific nature of many of the interventions, it is difficult to recommend specific interventions or to establish which component(s) should be present. There are a number of factors that need to be considered when evaluating the effect of interventions as outlined in this overview. Interventions need to be targeted towards individual settings, depending on patient and staff needs as well as already present approaches to prevent falls. The evidence table can help to show which interventions have been tried in practice and can help to broadly calibrate expected improvements.

Evaluations of tools

In this overview we also aimed to review the characteristics of existing tools that can assist in the prevention of falls in hospitals. There are numerous tools that hospital teams may choose with the intention of preventing falls, and the tools are often developed for the purpose of the intervention (e.g., a checklist or care protocol).

We have identified a large number of published tools as part of the searches for this literature review. These are checklists, videos demonstrating how to perform specific tests, or care algorithms. However, for the purposes of this evidence review, we were interested in tools that have known psychometric and/or diagnostic properties. Hence we specifically searched for reliability and validity data for existing tools. Other tools and programs not psychometrically evaluated in research studies or tested for effectiveness but shown in full are listed in the appendix (see Other example tools and interventions).

Search and review sources

We identified relevant tools through published reviews, included intervention studies (see Evidence table 1), existing toolkits, 'how-to' guides and clinical guidelines (see Published resources), through consultation with the research team, and personal files.

For tools that were deemed relevant, targeted searches were performed to identify the best available evidence on the psychometric and diagnostic performance of the tool. In electronic searches this encompassed searching for the tool's name (e.g., Morse scale) or category (e.g., fall risk assessment) with or without a filter for psychometric and diagnostic performance ("scale" OR "checklist" OR "assessment " OR "reliability" OR "validity" OR "diagnostic performance" OR "specificity" OR "sensitivity" OR "positive predictive value" OR "precision" OR "likelihood ratio" OR "predict*") depending on the publication volume associated with the tool. We searched the databases PubMed, CINAHL, PsycInfo, and the Web of Science to identify eligible evaluation studies.

Inclusion criteria

We selected studies reporting on the psychometric and diagnostic performance of tools relevant for falls prevention. For each tool, we aimed to select the best available and most applicable evidence, i.e., systematic reviews summarizing a number of individual studies on the tool performance or individual studies providing data from hospital settings.

Where no overviews were available, we selected individual study reports of psychometric or diagnostic properties. Due to the large number of fall risk assessment scales, individual research studies outside the hospital setting were not sought. Where more than one study was available for a tool, precedence was given to reviews or individual studies reporting data for acute hospital settings. Tools clearly not applicable to hospital settings, such as home assessments and postal surveys, were excluded.

Individual studies assessing tools for falls-related dimensions, such as postural stability, had to report on the sensitivity and specificity (the number of true and false positives and the number of true and false negatives; predictive validity) for the detection of fallers to be considered in this overview. Face validity information on tools was only considered where it was established in a formal assessment, e.g., through a survey, and the publication reported resulting data.

In order to maximize the applicability of performance results, preference was given to US hospital settings when more than one evaluation was available. We excluded rater assessment tools available only in non-English languages.

Data extraction

We abstracted information on the reliability and validity of the tools together with the name of the tool, the citation from which the data were abstracted, the study design (systematic review, review, or individual study), the number of studies the data were based on, and a brief description of the tool (e.g., purpose, format, number of items) as reported. We also recorded whether the tool had been applied in an acute care hospital setting as part of the evaluation and whether some or all of the reliability and validity estimates had been established in an US setting.

We abstracted information concerning the ability of the tool to produce reliable and reproducible results where applicable and differentiated the internal consistency (e.g., inter-item coherence), the temporal stability (e.g., test-retest correlations), and the inter-rater agreement (e.g., kappa, intra-class correlations for independent raters applying the test assessing the same patient). Where reported, we extracted the used statistical measure (e.g., kappa, intra-class correlation, Cronbach's alpha).

We also extracted information for evidence that the tool is valid, for example that an assessment scale measures what it is supposed to measure. Primarily we documented whether assessment tools were valid for the prediction of fall risk in patients. Other validity evaluation results for the included tools such as face validity assessments (does the tool appear to be useful and meaningful), content validity (is the concept sufficiently covered), construct validity (are the items a meaningful representation of the construct), or incremental validity (does the test provide additional information compared to other measures) were also abstracted where available.

Table 2 summarizes identified evidence on the reliability and validity of the selected tools. The references of included studies are listed in the appendix (see References of included tool evaluations).

Table 2: Evidence Table of Evaluations of Tools to Support the Reduction of Falls in Hospitals

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
Fall risk assessment Scales						
Assessment for High Risk to Fall (Spellbring)	Myers (2003); review, data from 1 study	Assessed domains: mental state, mobility, fall history, medication, elimination, vision, age, hearing, weakness, blood pressure, language, personality, footwear	Yes	n/a	Inter-rater agreement: 0.90	n/a
Conley Scale	Scott et al., 2007; systematic review, data from 1 study	6-items; score 2 used as cut-off	Yes	Yes	Inter-rater agreement: 0.80	Predictive validity: Sensitivity: 0.71, specificity: 0.59
Cumming's Paediatric Fall Assessment Scale	Harvey et al. (2010); individual study	6-items; score 0 = no risk, 1-7 = low risk, ≥8 = high risk; assessed domains: cognitive / psychological, equipment, functional status, history of falls, medications, seizures / epilepsy	Yes	Yes	Internal consistency (α): 0.68	n/a
Downton Score	Oliver et al. (2004); Systematic Review, data from	Assessed domains: known previous falls, medications, sensory deficits, confusion, and gait; score 3 used as cut-off	Yes	No	n/a	Predictive validity: Sensitivity: 0.91, (95% CI: 0.79, 0.97), specificity: 0.27 (95% CI: 0.18, 0.38), PPV: 0.44 (95% CI: 0.345, 0.54), NPV: 0.82 (95%

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
	1 study					CI: 0.62, 0.94), OR: 3.5 (95% CI: 1.2, 10.3)
Downton Index	Scott et al. (2007); systematic review, data from 1 study	Score 3 used as cut-off	Yes	n/a	n/a	Predictive validity: Sensitivity: 0.91, specificity: 0.27
Edmonson Psychiatric Fall Risk Assessment Tool	Edmonson et al. (2011); individual study	Assessed domains: age, mental status, elimination, medications, and diagnoses; score ≥90 used as cut-off	Yes	Yes	n/a	Predictive validity: Sensitivity: 0.63, specificity: 0.86
Elderly Fall Screening Test	Perell et al. (2001); review, data from 1 study	6 items; score 3 used as cut-off	No	n/a	n/a	Predictive validity: Sensitivity: 0.93, specificity: 0.78
Elderly Fall Screening	Scott et al. (2007); systematic review, data from 1 study	5 items; score ≥2 used as cut-off	No	n/a	n/a	Predictive validity: Sensitivity: 0.83, specificity: 0.69
Fall Assessment Questionnaire (Rapport)	Perell et al., 2001; review, data from 1 study	10-item scale; score 3 used as cut-off	Yes	Yes	n/a	Predictive validity: Sensitivity:0.73, specificity: 0.88
Fall Prediction Index	Perell et al., 2001; review, data from 1 study	8 items, score 5 used as cut-off	No	No	n/a	Predictive validity: Sensitivity:1, specificity: 0.44
Fall Risk Assessment (FRA)	Gates et al. (2008);	Score 10 and 16 used as cut-offs	n/a	n/a	n/a	Predictive validity: Sensitivity: 0.57 (95% CI: 0.42–0.71),

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
	systematic review, data from 1 study					specificity: 0.73 (95% CI: 0.68–0.78), PPV: 0.24 (95% CI: 0.17–0.34), NPV: 0.92 (95% CI: 0.88–0.95)
Fall Risk Assessment Scales (Forrester)	Myers (2003); review, data from 1 study	n/a	Yes	n/a	Inter-rater agreement: 0.79 to 0.82	n/a
Fall Risk Assessment Tool (FRAT)	Gates et al. (2008), systematic review, data from 1 study	2, 3, or 4 risk factors used as cut-offs	No	No	n/a	Predictive validity: Sensitivity: 0.15 (4 risk factors) to 0.59 (2 risk factors), specificity:0.80 (2 risk factors) to 0.97 (4 risk factors), PPV: 0.43 to 0.58, NPV: 0.82 to 0.88
Fall Risk Assessment tool (CHAMPS)	Harvey et al. (2010); individual study	6 assessed domains: age, mental status, functional status, history of falls, mobility impairment, motor deficit, parental involvement, safety	Yes	Yes	Internal consistency (α): 0.40	Predictive validity: Accuracy: 0.84
Fall-risk Screen Test (Tromp)	Scott et al. (2007); systematic review, data from 1 study	Score 7 used as cut-off	No	n/a	n/a	Predictive validity: Sensitivity: 0.54, specificity: 0.79
Falls risk for hospitalised older people (FRHOP)	Hill et al., 2004; Individual study	Tool designed to be completed by medical staff, nurse, occupational therapist, and physiotherapist; assessed domains: history of falls, medications, medical conditions, sensory loss and communications, cognitive status, continence, nutritional conditions, functional behavior, feet and footwear and clothing, balance, transfer and mobility	Yes	No	Test-Retest (ICC): 0.95 (95% CI: 0.84, 0.99); Inter-rater agreement (ICC): 0.85 (95% CI: 0.55, 0.95)	Predictive validity: Sensitivity: 0.57, specificity: 0.68

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
General Risk Assessment for Pediatric Inpatient Falls Scale (Graf-PIF)	Graf et al. (2008); individual study	5 items, score ≥2 = high risk; assessed domains: length of stay, orthopedic diagnosis, physical / occupational therapy, seizure medication, IV / heparin lock free	Yes	Yes	n/a	Predictive validity: Sensitivity: 0.75, specificity:0.76
General Risk Assessment for Pediatric Inpatient Falls Scale (Graf-PIF)	Harvey et al. (2010); individual study	5 items, score ≥2 = high risk; assessed domains: length of stay, orthopedic diagnosis, physical / occupational therapy, seizure medication, IV / heparin lock free	Yes	Yes	Internal consistency (α): 0.77, Inter-rater agreement (accuracy): 0.84	n/a
Hendrich II Fall Risk Model / Assessment	Myers (2003); review, data from 1 study	Assessed domains: mental state, gait / mobility, fall history, elimination, diagnosis, continence, mood, dizziness, weakness	Yes	n/a	n/a	Predictive validity: Sensitivity: 0.77, specificity: 0.72
Humpty Dumpty Falls Risk Assessment Tool	Harvey et al. (2010); individual study	7 items; assessed domains: <24 hrs post-operative / sedation, ≤ 3years, environment, history of falls, illness acuity, medications, neuro/sensory status, seizures / epilepsy	Yes	Yes	Internal consistency (α): 0.64	n/a
Humpty Dumpty Falls Risk Assessment Tool	Hill-Rodriguez et al. (2008); individual study	7 items; assessed domains: age, gender, diagnosis, cognitive impairments, environmental factors, response to surgery or sedation or anesthesia, medication usages; range of scores 7-23, score 12 = high risk	Yes	yes	Inter-rater agreement: ≥0.7	Predictive validity: Specificity: 0.24, sensitivity: 0.85, PPP:0.53, NPP:0.63, accuracy: 0.59
I'M SAFE, Children's Hospital Denver / CNMC (I'M SAFE Fall Risk Assessment Tool)	Harvey et al. (2010); individual study	Assessed domains: environment, history of falls, intravenous, medications, orthopedic / muscular, rehab / OT / PT, seizures / epilepsy	Yes	Yes	Internal consistency (α): 0.69	n/a
Innes Score (St Francis)	Oliver et al. (2004); systematic review, data from 1 study	Assessed domains: previous trauma, disorientation, impaired judgment, sensory disorientation, muscle weakness, multiple diagnoses, and language barrier	n/a	No	n/a	Predictive validity: Sensitivity: 0.89 (95% CI: 0.78, 0.96), specificity: 0.74 (95% CI: 0.72, 0.75); PPV: 0.07 (95% CI: 0.05, 0.10), NPV: 1.00 (95% CI: 0.99, 1.00), OR: 23 (95%

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
						CI: 10.1, 55.5)
Maine Medical Center, Fall Risk Assessment/Interventions	Chapman et al. (2011); Individual study	9 assessed domains: age, mental status, days in the hospital, elimination, history of falling, impaired vision, confined to bed or chair, impaired mobility/gait, and medications; score ≤9 = low risk, 10-17 = moderate risk, ≥18 = high risk	Yes	Yes	Internal consistency (α): 0.68	Predictive validity: Sensitivity: 0.65, specificity: 0.66, PPV: 0.07, NPV: 0.98
Mobility Interaction Fall Chart	Scott et al. (2007); systematic review, data from 2 studies	n/a	No	n/a	Inter-rater agreement: 0.80	Predictive validity: Sensitivity ranged from 0.43 to 0.85, specificity ranged from 0.69 to 0.82
Morse Falls Scale (MFS)	Harrington et al. (2010); systematic review, data from 4 studies	n/a	Yes	n/a	n/a	Predictive validity: Sensitivity: 0.72 to 0.96, specificity 0.51 to 0.83
Morse Score	Oliver et al. (2004); systematic review, data from 2 studies	Score 45 used as cut-off	Yes	No		Predictive validity: Sensitivity: 0.73 to 0.96, specificity: 0.54 to 0.75, PPV: 0.04 to 0.10, NPV: 0.99 to 1.00.
Morse Falls Scale (MFS)	Scott et al., 2007; systematic review, data from 3 studies	6 items	Yes	n/a	Inter-rater agreement: 0.96 to 0.98.	Predictive validity: Sensitivity: 0.72 to 0.83, specificity: 0.51 to 0.68
Falls and Injury Risk Assessment Tool / New York-Presbyterian	Chapman et al. (2011);	5 items; assessed domains: medication, history of falls, impaired mobility, gender, and impaired	Yes	Yes	Internal consistency (α): 0.69	Predictive validity: Sensitivity: 0.79, specificity: 0.58, PPV: 0.07, NPV: 0.99

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
	Individual study	cognition; score ≤3 = low risk, 4-6 = moderate risk, ≥7 high risk				
New York-Presbyterian Falls-Injury Risk Assessment Tool	Currie et al. (2004); individual study	5 items; assessed domains: fall history, gender, gait, assistive devices, cognition, sedatives	Yes	Yes	n/a	Predictive validity: Sensitivity: 0.674, specificity: 0.60
Nurse-led Assessment of Fall Risk (Price)	Myers (2003); review, data from 1 study	Assessed domains: gait / mobility, fall history, vision, diagnosis	Yes	n/a	n/a	Predictive validity: Sensitivity: 0.90, specificity: 0.38
Patient Fall Tool (Tack et al.)	Myers (2003); review, data from 1 study	Assessed domains: prior falls, mental status, medications, physical condition, preventive measures, follow-up	Yes	n/a	Inter-rater agreement: 0.82	n/a
Peter James Centre Falls Risk Assessment Tool (PJC-FRAT)	Haines et al., 2006; individual study	A tool requiring input from nursing staff, physiotherapy staff, occupational therapy staff, and medical staff	No	No	n/a	Predictive validity: Sensitivity: 0.73 (95% CI: 0.55- 0.90), specificity of 0.75 (95% CI:0.66 - 0.83)
Schmid Fall Risk Assessment Tool	Oliver et al. (2004); systematic review, data from 1 study	5 items; assessed domains: gait, confusion, assisted toileting, fall history, and anticonvulsants; score 3 used as cut-off	n/a	Yes	n/a	Predictive validity: Sensitivity: 0.93 (95% CI: 0.80, 0.98), specificity: 0.78 (95% CI: 0.73, 0.83), PPV: 0.37 (95% CI: 0.27, 0.47), NPV: 0.99 (95% CI: 0.96, 1.00), OR: 44.3 (95% CI: 13.2, 172.4)
(Schmid) Fall Risk Assessment	Scott et al. (2007); systematic review, data from 2 studies	17 items; score 3 used as cut-off	Yes	Yes	Inter-rater agreement: 0.88	Predictive validity: Sensitivity: 0.91 to 0.93, specificity: 0.25 to 0.78
Scott and White Falls Risk Screener	Yauk et al. (2005); individual	4 items; score ≥1 used as cut-off; assessed domains: history of falls, ambulation assistance, disoriented,	Yes	Yes	n/a	Predictive validity: Sensitivity: 0.70, specificity: 0.57

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
	study	bowel control problems				
Simplified Fall-Risk Assessment Tool	Salameh et al (2008); individual study	Assessed domains: history of previous fall, impaired mobility, use of walking aid, confusion or altered mental state, impairing medical condition	Unclear? (patients who failed during 1 year period)	No	n/a	Predictive validity: Pts with history of falls sensitivity: 0.67, specificity: 0.63 Pts who fell during hospitalization sensitivity:0.64, specificity: 0.68
Spartanburg Fall Risk Assessment	Kehlinde (2003); systematic review, data from 1 study	4 items	n/a	n/a	Inter-rater agreement: 0.90	Predictive validity: Sensitivity: 1; specificity: 0.28
St Thomas's risk assessment tool in falling elderly inpatients (STRATIFY)	Oliver et al. (2008); systematic review, data from 9 studies	5 items; score ≥2 used as cut-off	Yes	No	n/a	Predictive validity: Pooled sensitivity from geriatric rehabilitation settings (4 studies): 0.76 (95% CI: 0.56, 0.76), corresponding specificity: 0.59 (95% CI: 0.55, 0.63)
STRATIFY	Harrington et al. (2010); systematic review, data from 12 studies	5 items	n/a	n/a		Sensitivity ranged from 0.11 to 1.00, specificity ranged from 0.07 to 0.90
STRATIFY	Scott et al. (2007); systematic review, data from 3 studies	5 items; score 2 or 9 used as cut-off	Yes	Yes	Inter-rater agreement: 0.74 to 0.78	Predictive validity: Sensitivity ranged from 0.66 to 0.93, specificity ranged from 0.47 to 0.88
Tinetti Mobility Scale / Tinetti Fall Risk Index	Gates et al. (2008);	n/a	n/a	n/a	n/a	Predictive validity: Sensitivity ranged from 0.27 to 0.76,

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
	systematic review, data from 4 studies					specificity ranged from 0.52 to 0.83, positive predictive value ranged from 0.31 to 0.68, negative predictive value ranged from 0.67 to 0.88
Tullamore	Vasallo et al. (2005); individual study	Assessed domains: sex, age, gait, sensory deficits, falls history, medication, medical history, mobility; score 9 used as cut-off	Yes	No	n/a	Predictive validity: Sensitivity: 0.91, specificity: 0.41, PPV: 0.23, NPV: 0.96
Western Health Falls Risk Assessment (WHeFRA)	Walsh et al. (2010); individual study	WHeFRA 2 stages fall risk screening and falls risk-factors assessment tool; 1st stage identifies high-risk pts; score range = 0-19; WHeFRA 10: score 10 used as cut-off for high risk, WHeFRA13: score 13 = high- risk; 2nd stage: assessment of 13 risk factors to rate the risk of specific factors	Yes	No	(presumably) Test-retest stability (ICC): 0.94 (95% CI: 0.86, 0.97) Inter-rater agreement (ICC): 0.78 (95% CI: 0.61, 0.88)	Predictive validity: Cut-off 10 sensitivity: 0.93 (95% CI: 0.64, 1) to 0.86 (95% CI: 0.5, 1), specificity: 0.57 (95% CI: 0.44, 0.71) to 0.77 (95% CI: 0.70, 0.85), Youden index: 0.5 (95% CI: 0.22, 0.67) to 0.63 (95% CI: 0.28, 0.83) Cut-off 13 sensitivity: 0.93 (95% CI: 0.64, 1) to 0.86 (95% CI: 0.5, 1), specificity: 0.76 (95% CI: 0.64, 0.89), 0.92 (95% CI: 0.87, 0.97), Youden index: 0.69 (95% CI: 0.42, 0.85) to 0.78 (95% CI: 0.43-0.95)
Other measures used as fall risk assessment						
Activity-based Balance and Gait	Scott et al. (2007); systematic review, data from 1 study	n/a	No	n/a	n/a	Predictive validity: Sensitivity: 0.72, specificity: 0.57
ADAPT Fall Assessment	Browne et	Computerized information system,	Yes	Yes	n/a	Concurrent validity:

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
Tool	al. (2004); individual study	fall risk is embedded into routine assessment documentation, program allows tailored interventions for specific patient risks, risk information is integrated into care plan, report sheets, and care conferences				Risk assessment correlates 0.96 with Hendrich scale scores
Area ellipse of postural sway	Scott et al. (2007); systematic review, data from 1 study	n/a	No	n/a	Inter-rater agreement: 0.72	n/a
Balance scale of the Performance Oriented Mobility Assessment (B-POMA) POAM-B, Tinetti	Scott et al. (2007); systematic review, data from 1 study	Score 12 used as cut-off	No	n/a	n/a	Predictive validity: Sensitivity: 0.55, specificity: 0.97
Balance self efficacy	Scott et al., 2007; systematic review, data from 1 study	18 items	No	n/a	n/a	Predictive validity: Sensitivity: 0.83, specificity: 0.38
Berg Balance Test	Perell et al., 2001; review, data from 1 study	14 items; score 49 used as cut-off	Yes	n/a	Inter-rater agreement: 0.95	Predictive validity: Sensitivity: 0.77, specificity: 0.86
Care Dependency Scale	Kehinde (2009); systematic review, data from 1 study	15 items	Yes	No	n/a	Predictive validity: Sensitivity: 0.60 to 0.74, specificity: 0.60 to 0.74

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
Clinical judgment	Myers et al. (2003); individual study	n/a	Yes	No	Test-retest stability (ICC): 0.90	Specificity: 0.26, sensitivity: 0.88, PPV: 0.18, NPV: 0.92
Clinical judgment	Webster et al. (2010); individual study	Nurse caring for the pt asked if they thought the pt was as risk of falling (yes vs no)	Yes	No	n/a	Predictive validity: specificity: 0.38, sensitivity: 0.84, PPV: 0.12, NPV: 0.96
Clinical Test sensory interaction for balance (CTSIB)	Scott et al. (2007); systematic review, data from 1 study	4 items	No	n/a	n/a	Predictive validity: Test correctly classified 80.8% (OR 12.9, 95% CI: 1.0, 159.8) of non-recurrent and recurrent fallers
modified Clinical Test of Sensory Organization and Balance (CTSIB)	Gates et al. (2008); systematic review, data from 1 study	>1 SD from age-based mean used as cut-off	n/a	n/a	n/a	Predictive validity: Sensitivity: 0.13 to 0.43, specificity: 0.61 to 0.93, PPV: 0.12 to 0.35, NPV: 0.82 to 0.85
Confusion and Mobility Status (Bakarich)	Myers (2003); review, data from 1 study	Assessed domains: mental state, gait/mobility	No	n/a	n/a	Predictive validity: Sensitivity: 0.54, specificity: 0.78, PPV: 0.97, NPV: 0.13
diffTUG	Andersson et al (2006); individual study	Assessed domains: basic functional mobility; 4.5 seconds used as cut-off	Yes	No	n/a	Predictive validity: Sensitivity: 0.17, specificity: 0.95, PPV: 0.63, NPV: 0.70
Dynamic gait index	Scott et al. (2007); systematic review, data from 1 study	8 items	No	n/a	Inter-rater agreement: 0.80	n/a

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
Dynamic Posturography	Gates et al. (2008); systematic review, data from 1 study	n/a	n/a	n/a	n/a	Predictive validity: Sensitivity: 0.37 (95% CI: 0.25, 0.50), specificity: 0.75 (95% CI: 0.68, 0.80), PPV: 0.30 (95% CI: 0.24, 0.47), NPV:0.80 (95% CI: 0.74, 0.85)
Elderly mobility scale	Scott et al., 2007; systematic review, data from 1 study	4 items	Yes	Yes	Inter-rater agreement: 0.88	n/a
Five Minutes Walk	Scott et al. (2007); systematic review, data from 1 study	1000 feet used as cut-off	No	n/a	n/a	Predictive validity: Sensitivity: 0.82, specificity: 0.79
Five-step Test	Scott et al. (2007); systematic review, data from 1 study	21 seconds used as cut-off	No	n/a	n/a	Predictive validity: Sensitivity: 0.82, specificity: 0.82
Floor Transfer	Scott et al. (2007); systematic review, data from 1 study	Unable/able used as cut-off	No	n/a	n/a	Predictive validity: Sensitivity: 0.64, specificity: 1.00
Functional Reach Test	Scott et al. (2007); systematic review, data from 4 studies	6.0'' used as cut-off	Yes	n/a	n/a	Predictive validity: Sensitivity: 0.76, specificity: 0.34

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
Lateral Reach	Scott et al. (2007); systematic review, data from 1 study	n/a	No	n/a	Inter-rater agreement: 0.99	n/a
Maximum Step Length	Scott et al. (2007); systematic review, data from 1 study	n/a	No	n/a	Inter-rater agreement: 0.86	Predictive validity: Significant predictor of recurrent fallers (OR 0.52)
Mobility Screen	Gates et al. (2008); systematic review, data from 1 study	n/a	n/a	n/a	n/a	Predictive validity: Falls: sensitivity: 0.74 (95% CI: 0.64, 0.83), specificity: 0.57 (95% CI: 0.50, 0.63), PPV: 0.40 (95% CI: 0.32, 0.47), NPV: 0.85 (95% CI: 0.78, 0.90). Recurrent falls: sensitivity: 0.84 (95% CI: 0.70, 0.93), specificity: 0.53 (95% CI: 0.47, 0.60), PPV: 0.23 (95% CI: 0.17, 0.30), NPV: 0.95 (95% CI: 0.90, 0.98)
Mobility Fall Chart (Lundin-Olsson)	Gates (2009); systematic review; data from 2 studies	n/a	n/a	n/a	n/a	Predictive validity: Sensitivity:0.43 (95% CI: 0.34, 0.53) to 0.85 (95% CI: 0.68, 0.95), specificity: 0.69 (95% CI: 0.59, 0.78) to 0.82 (95% CI: 0.68, 0.92), PPV: 0.58 (95% CI: 0.47, 0.69) to 0.78 (95% CI: 0.62, 0.88), NPV: 0.55 (95% CI: 0.46, 0.63) to 0.88 (95% CI: 0.75, 0.95)
Mobility Fall Chart	Kehlinde	Screening tool, 5 to 15 minutes to	n/a	n/a	Inter-rater agreement: 0.80	Predictive validity:

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
(Lundin-Olsson)	(2009); systematic review; data from 2 studies	complete				Sensitivity:0.43 to 0.85, specificity: 0.69 to 0.82
Modified Gait Abnormality Rating scale	Perell et al. (2001); systematic review, data from 1 study	7 items; assessed domains: variability, guardedness, staggering, foot contact, hip ROM, shoulder extension, arm-heel-strike synchrony	No	Yes	Inter-rater agreement: 0.58 to 0.60	n/a
9-Test Battery	Gates et al. (2008); systematic review, data from 1 study	n/a	n/a	n/a	n/a	Predictive validity: Sensitivity: 0.50 (95% CI: 0.27, 0.73), specificity: 0.43 (95% CI: 0.32, 0.53), PPV: 0.13 (95% CI: 0.07, 0.25), NPV: 0.83 (95% CI: 0.69, 0.91)
One-Leg Balance	Gates et al. (2008); systematic review, data from 1 study	n/a	n/a	n/a	n/a	Predictive validity: Sensitivity: 0.36 (95% CI: 0.25, 0.48), specificity: 0.77 (95% CI: 0.72, 0.82), PPV: 0.31 (95% CI: 0.22, 0.42), NPV: 0.81 (95% CI: 0.75, 0.85)
One-leg stance test (OLST)	Thomas et al. (2005); individual study	1.02 seconds used as cut-off	n/a	No	(presumably) Inter-rater agreement (ICC): 0.69	Predictive validity: Sensitivity: 0.67 (95% CI: 0.39, 0.86), specificity: 0.89 (95% CI: 0.67, 0.97)
Physiological Profile Assessment (PPA)	Lord et al. (2003); review, data from 2 studies	Long from and short version (for acute care setting); assessed domains: vision tests (high and low-contrast visual acuity, contrast sensitivity), vestibular function tests (visual field dependence), peripheral sensation tests (tactile sensitivity, vibration sense, proprioception), muscle force tests, reaction time	Yes (shorter version suitable to acute setting)	No	Test-retest stability (ICC): 0.50 (Proprioception) to 0.97 (Knee extension force)	Predictive validity: Accuracy (differentiating fallers and non-fallers): 75 to 79%

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
		tests, balance tests				
Postural balance testing	Scott et al. (2007); systematic review, data from 1 study	6 items	No	n/a	n/a	Predictive validity: Sensitivity: 0.80, specificity: 0.43
Postural stability	Scott et al. (2007); systematic review, data from 1 study	n/a	No	n/a	n/a	Predictive validity: Sensitivity: 0.14, specificity: 0.94
Quantitative Gait	Scott et al. (2007); systematic review, data from 1 study	n/a	No	n/a	n/a	Predictive validity: Insignificant predictor of fallers
Rapid Step	Scott et al. (2007); systematic review, data from 1 study	n/a	No	n/a	Inter-rater agreement: 0.42	Predictive validity: Poor predictor of recurrent fallers (OR 0.98)
Resident Assessment Instrument	Perell et al. (2001); systematic review, data from 1 study	99 items	No	Yes	Inter-rater agreement: 0.79	n/a
75% Limits of Stability	Gates et al. (2008); systematic review, data from	>1 SD from age-based mean used as cut-off	n/a	n/a	n/a	Predictive validity: Sensitivity: 0.33 to 0.63, specificity: 0.46 to 0.76, PPV: 0.16 to 0.22, NPV: 0.83 to 0.87

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
	1 study					
Step up test	Scott et al. (2007); systematic review, data from 1 study	n/a	No	n/a	n/a	n/a
Stops Walking When Talking	Beauchet et al. (2009)	Dual-task gait assessment comparing task performance whilst walking and simultaneously executing an attention-demanding task	Yes	n/a	n/a	Predictive validity: Pooled OR (15 studies) for falls: 5.3 (95% CI: 3.1, 9.1), sensitivity: ranged from 0.17 to 0.87, specificity ranged from 0.55 to 0.97
Tandem Stance	Scott et al. (2007); systematic review, data from 1 study	Unable / able used as cut-off	No	n/a	n/a	Predictive validity: Sensitivity: 0.55, specificity: 0.94
Timed Chair Stands	Scott et al. (2007); systematic review, data from 1 study	n/a	No	n/a	Inter-rater agreement: 0.63	n/a
Timed Up & Go test (TUG)	Scott et al. (2007); systematic review, data from 1 study	10-12 used as cut-off	No	n/a	Inter-rater agreement: ranged from 0.56 to 0.99	Construct validity: Judged as 'good'
Timed Walk	Scott et al. (2007); systematic review, data from	n/a	No	n/a	Inter-rater agreement: 0.88	n/a

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
	1 study					
Timed Walk / Distance Walked	Gates et al. (2008); systematic review, data from 1 study	1000 feet used as cut-off	n/a	n/a	n/a	Predictive validity: Sensitivity: 0.82 (95% CI: 0.52, 0.95), specificity: 0.44 (95% CI: 0.33, 0.57) PPV: 0.21 (95% CI: 0.11, 0.35), NPV: 0.93 (95% CI: 0.78, 0.99)
Tinetti Balance Subscale	Scott et al. (2007); systematic review, data from 1 study	6 items	No	n/a	Inter-rater agreement: 0.98	Predictive validity: Significant predictor of recurrent fallers (incidence density ratio: 1.17, 95% CI: 1.01, 1.34)
Tinetti Gait Subscale	Gates et al. (2008); systematic review, data from 3 studies	n/a	n/a	n/a	n/a	Predictive validity: Sensitivity: 0.20 to 0.68, specificity: 0.85 to 0.96, PPV: 0.50 to 0.71, NPV: 0.80 to 0.86
Walking While Talking (WWT) Complex	Gates et al. (2008); systematic review, data from 1 study	n/a	n/a	n/a	n/a	Predictive validity: Sensitivity: 0.93, specificity: 0.44, PPV: 0.21, NPV: 0.82
Falls reporting methods						
Case notes, hospital incident reporting system, patient self report	Hill et al. (2010); individual study	3 reporting methods (pts self-report, fall events reported in pts case notes, falls events reported through hospital reporting system)	Yes	No	n/a	Incremental test validity: Detection of falls events: Patient case notes > hospital incident reporting systems > patient self report
Fall evaluation service	Shorr et al. (2008); individual	Trained nurse	Yes	Yes	n/a	Incremental test validity: Fall evaluator identified 4.45 compared to 3.73 falls / 1000

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
	study					patient-days as per incident reports
Shift Coupon	Kellog et al. (2006); individual study	Anonymous method for nurses to report adverse events; 12 items	Yes	Yes	n/a	Incremental test validity: There were no significant differences between the number of falls reported on the Shift coupons versus incident reports
Situation-Background-Assessment-Recommendation (SBAR)	Andreoli et al. (2010); individual study	Situational briefing model targeting clinical and non-clinical staff	No	No	n/a	Incremental test validity: Frequency of falls reported increased 8% (n.s.)
Other tools related to falls assessment or falls prevention						
Bed-exit alarm system	Hilbe et al. (2010); individual study	Bed-exit alarm system applied at bed side rails	n/a	No	n/a	Predictive validity: Sensitivity: 0.96, specificity: 0.96
Educational poster to prevent falls	Jeske et al. (2006); individual study	Stop sign saying "Stay Safe, Stay Put You are sick – call for help"	Yes	Yes	n/a	Face / construct validity: 81% pts and families stated the poster caught their attention, 84% thought the poster was an effective idea for fall prevention, 92% stated the directions were easy to follow
Fall Prevention Education DVD	Hill et al. (2009); individual study	DVD for falls prevention education, based on health belief model framework	Yes	No	n/a	Incremental validity: Compared to written workbook pts had higher self-perceived risk of falling (p=0.04), higher levels of confidence (p+0.03) and motivation (p=0.04) to engage in self-protective

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
						strategies
Fall Tailoring Interventions for Patient Safety (Fall T.I.P.S. / TIPS) Toolkit	Zuyev et al. (2011); individual study	Electronic decision support intervention software, output tools bed poster, plan of care, patient education handout	Yes	Yes	n/a	Face / construct validity: Usability assessment resulted in various requested changes to software, patient education printouts, and plan-of care printout requested; bed poster sign received approval
Fracture Risk Assessment tool (FRAX)	Toyabe (2010); individual study	Fracture risk assessment tool developed by the WHO	Unclear	No	n/a	Predictive validity: Falls/Test dataset sensitivity: 0.496 (95% CI: 0.443, 0.548), specificity: 0.666 (95% CI: 0.657, 0.675) Fracture after fall/Test dataset sensitivity: 0.700 (95% CI: 0.397, 0.892), specificity: 0.661 (95% CI: 0.652, 0.670)
Fall (Tailoring Interventions for Patient Safety (TIPS) / Fall T.I.P.S. icons	Hurley et al. (2009); individual study	Signs to communicate fall risk status, placed above patients' beds	Yes	Yes	n/a	Face / content validity: Team agreement about displaying simple text with each icon to improve recognition and interpretation of the fall risk and assessment concepts.
Post-Fall Index	Gray-Miceli et al. (2006); individual study	30-item post-fall assessment tool; assessed domains: fall history, physical examination, function and behavior, environment	No	Yes	Inter-rater agreement (κ) for individual items ranged from 0.36 to 1.00	Construct / face validity: Expert assessment: 65% of items were determined to have clinical value
Self-Efficacy for Prevention Falls Nurse and Assistant scales	Dykes et al. (2010); individual study	11-item and 8-item self-efficacy tools to assess nursing staff performance	Yes	Yes	Internal consistency (α) 11-item tool: 0.89, Internal consistency (α) 8-item tool: 0.74	n/a
Other tools, not falls specific						

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
Organizational readiness to change assessment (ORCA)	Helfrich et al. (2009); individual study	Questionnaire with 3 major scales corresponding to core elements of PARIHS framework: 1) strength and extent of evidence for the clinical practice changes represented by the QI program, 4 subscales, 2) quality of the organizational context for the QI program, 6 subscales, 3) capacity of the internal facilitation of the QI program, 9 subscales; 3-6 items per subscale	Yes	Yes	Internal consistency (α): Evidence scale: 0.87, Context scale: 0.85, Facilitation scale: 0.95	Factorial validity: Principal factor analysis with promax rotation: 3/4 subscales loaded on the evidence factor, 5/6 subscales loaded on the context factor, 8/9 subscales loaded on the facilitation factor
Geriatric Institutional Assessment Profile (GIAP)	Boltz et al. (2009); individual study	Questionnaire for registered nurses and other health care professionals to assess a hospital's readiness to implement geriatric programs; 68 questions, 152 items	Yes	Yes	Internal consistency (α): Ranged from 0.65 (Geriatric nursing knowledge / attitudes scale) to 0.94 (Geriatric care environment scale; Professional issue: Staff disagreement Test-retest stability (ICC): ranged from 0.82 (Capacity for collaboration) to 0.92 (Professional Issue: Perceived legal vulnerability scale, Burden of upsetting behaviors scale)	n/a
Geriatric Care Environment Scale (GCES)	Kim et al. (2009); individual study	Questionnaire to assess healthcare professionals' perceptions of how care provided to older adults reflects age-sensitive principles and the organizational practice environment that supports or hinders care delivery (part of GIAP); 28 items	Yes	Yes	Internal consistency (α): 0.93	Factorial validity: 4-factor structure (Aging-sensitive care delivery, resource availability, institutional values regarding older adults and staff, capacity for collaboration) accounts for 55% of the variance (originally

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
						3 scales), RMSEA: 0.058, 4-factor structure stable across four different types of hospitals (RMSEA: 0.027)
Bedside cognitive screening instruments	Nelson et al. (1986); systematic review	Mini-Mental State Examination (MMS), Cognitive Capacity Screening Examination (CCSE), Mattis Dementia rating Scale (DRS), Kahn's Mental Status Questionnaire (MSQ), and Short Portable Mental Status Questionnaire (SPMSQ)	n/a	n/a	MMS: 0.83 to 0.99; CCSE inter-rater agreement: 1.00, DRS Test-retest stability: 0.84; MSQ Test-retest stability: in 75% of the readmissions there was a change of at most 1 point among clinically stable patients; SPMSQ Test-retest stability: 0.80	Predictive validity: All tools had substantial false-negative rates.
Dementia screening and case-finding single domain tests	Mitchell et al. (2010); review	15 single-domain screening and case finding tools for the detection of dementia were included in the review such as memory impairment screen (MIS), selective reminding test (SRT), memory alteration test (MAT)	n/a	n/a	n/a	Predictive validity: In community settings, best pooled (3 studies) performance for screening (AUC<0.80) and case finding (AUC>=0.80) was found for MIS. In primary care settings, SRT and clock drawing test were the best for screening (AUC<0.80) and case finding (AUC<0.80). In specialist settings, MAT was the best for screening (AUC>=0.80) and case finding (AUC>=0.80)
Dementia screening and case-finding multi-domain tests	Mitchell et al. (2010); review	29 multi-domain screening and case finding tools for the detection of dementia were included in the review such as abbreviated mental test score (AMTS), 6 item Cognitive Impairment Test (6-CIT)	n/a	n/a	n/a	Predictive validity: Abbreviated mental test score AMTS pooled from 2 studies was found best in primary care settings; case finding: AUC >=0.80, screening AUC>=0.80. In specialist settings, the 6-CIT and the MINI-COG were best.

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
						6-CIT case finding: AUC >=0.80, screening: AUC>=0.80, MINI-COG: case finding: AUC >=0.80, screening: AUC>=0.80
Delirium assessment	Wong et al. (2010); systematic review	11 measures were included in the review such as Confusion Assessment Method (CAM)	n/a	n/a	n/a	Predictive / face validity: Pooled analysis (12 studies) found that CAM is the best for ease of use, test performance, and clinical importance of the heterogeneity. CAM pooled sensitivity: 0.86 (95% CI: 0.74, 0.93), specificity: 0.93 (95% CI: 0.87, 0.96), LR+: 9.6 (95% CI: 5.8, 16.0), LR-: 0.16 (95% CI: 0.09, 0.29)
Balance measures	Tyson & Connell (2009); systematic review	19 measures were included in the review			Brunel Balance Assessment, Berg Balance Scale, Trunk Impairment Scale, arm raise and forward reach tests in sitting and standing, weight shift, step/tap and step-up tests demonstrated sufficient psychometric properties	Predictive / incremental test validity: The Brunel Balance Assessment and its associated functional performance tests are a hierarchical scale avoiding redundancy.
Psychological outcomes of falling	Jorstad, 2005; systematic review	23 instruments were included in the review such as Activities-specific Balance and Confidence Scale (ABC), Activities-specific Balance and Confidence Scale United Kingdom (ABC-UK), amended Falls Efficacy Scale (amFES), Concern about Falling Measure (CaF), Consequences of Falling Scale (CoF), Confidence in maintaining	n/a	n/a	FES α: 0.90 rFES α: 0.95; mFES α: 0.95; FES-UK α: 0.97; ABC α: 0.96; ABC-UK α: 0.98; CONFbal α: 0.89 to 0.91; MES α: 0.82; SAFFE α: 0.91, UIC FFM α: 0.93;	Construct validity: Extreme group comparison FES: high mobility vs low mobility (p<0.001); fear of falling vs not (p<0.001); avoid activity vs not (p<0.001); FES-UK: fallers vs nonfallers (p<.001); previous fractures vs not, aged>60 vs <60 (p<0.05); ABC: high vs low mobility

Category	Citation, Study design, # of studies	Tool description	Tested in acute hospital setting	Sample includes US setting	Reliability	Validity
		balance Scale (CONFbal), Falls Efficacy Scale (FES); Falls Efficacy Scale United Kingdom (FES-UK), Mobility Efficacy Scale (MES), modified Falls Efficacy Scale (mFES), modified Survey of Activities and Fear of Falling in the Elderly (mSAFFE), revised Falls Efficacy Scale (rFES), Survey of Activities and Fear of Falling in the Elderly (SAFFE), University of Illinois at Chicago Fear of Falling Measure (UIC FFM), Are you afraid of falling? (Instrument 1), Has fear of falling made you avoid any activities? (Instrument 6)			CaF α: 0.93 mSAFFE α: 0.91 to 0.92; CoF α: 0.86 to 0.94; Instrument 1: Test-retest (κ): 0.66; Instrument 6: Test-retest (κ): 0.36	($p<0.001$); fear of falling vs not ($p<0.001$); avoid activity vs not ($p<0.001$), low vs high mobility ($p<0.001$); ABC-UK: fallers vs nonfallers ($p<0.001$), previous fractures vs not, aged>60 vs <60 ($p<0.001$). Incremental test / face validity: All scales were considered useful in some conditions.

Note: The validity assessment included diagnostic performance data; α: Cronbach's alpha; CI: Confidence interval; ICC: intra-class correlation; κ: kappa; OR: odds ratio; PPV: positive predictive value; NPV: negative predictive value; LR+: positive likelihood ratio; LR-: negative likelihood ratio; QI: quality improvement

Results

The review identified a wide variety of tools, including fall risk assessment scales, other measures used as falls predictors, falls reporting methods, other tools used in falls prevention, and potentially relevant tools that are not falls or falls prevention specific. The large majority of the documented tools are fall risk assessment scales followed by related measures used for falls prediction.

We tried to identify systematic reviews of studies on each of the tools or categories of tools but for some tools, only individual research studies were available. Systematic reviews have the advantage of identifying and combining data from multiple studies but the disadvantage of not necessarily describing the individual tools in detail (e.g., the number of items and assessed domains). Nonetheless, comparing this kind of information among individual tools, when reported, it is apparent that tools vary considerably in how much effort and time would be involved in integrating the tool into clinical practice. Within tool categories, there was great variation in the complexity of tools, including for example the number of items in fall risk assessment tools.

For this collection of tools, preference was given to studies evaluating the tool in acute care hospital settings rather than community or long-term care setting. However, some of the identified tools do not appear to have been tested in acute care settings and their suitability needs to be assessed carefully before implementation.

When reported, the reliability of tools varied and is not known for some of the identified tools. Established test statistics are based on a scale ranging from 0 to 1, with higher values expressing more reliability. There are different standards for various reliability measures (e.g. internal consistency versus test-retest correlations), and estimates also depend on the exact statistics used (e.g., kappa versus intra-class correlations). In this overview, data often came from systematic reviews that did not specify which measures and statistics were used, making it difficult to compare different tools directly. However, the table provides “ballpark” figures, and it is apparent that some tests are more reliable than others.

The validity of the included tools was most often estimated by establishing the predictive validity of the tool. For fall risk assessments it was tested whether the instrument can accurately differentiate fallers from non-fallers. In many cases the evaluation was not done prospectively, but rather retrospectively when test values and outcomes were known. In addition, unless otherwise specified in the study, the test developer may not have been blind to the outcome when establishing the measure and appropriate cut-offs. In summary, a number of confounding factors distort the validity assessment. However, the shown tools all have undergone some psychometric testing, which sets them apart from dozens of other tools used in falls prevention practice.

Fall risk assessment scales

A large number of fall risk assessment scales have been published. Table 2 shows only those instruments for which reliability and validity data are available in the literature. Many instruments were included in systematic reviews that aimed to identify all studies available for a particular scale. However, oftentimes data were only based on one study. Very few measures,

such as the Morse Fall Scale and the STRATIFY scale, have been applied in a number of studies and have generalizable reliability and validity estimates.

The scales were often designed as geriatric measures but most were described as suitable for assessment in all adults. A few assessment scales were identified that were designed to assess the risk of falling in hospitalized children. It is also noteworthy that several fall risk assessment scales already include diverse aspects, in particular factors relevant for general geriatric care such as mental state exams; for a detailed overview see Myers (2003). In practice, the chosen measures have to be assessed for conceptual overlap, which may indicate the need for a more parsimonious approach to the assessment of patients.

Other measures used as falls predictors

A large number of other tools have also been applied to assess falls risk. Several of the measures showed predictive validity comparable to fall risk scales. In particular, results for clinical judgments are noteworthy, challenging the incremental test validity of assessment scales, i.e., the information increase through the use of a formal assessment instrument.

Falls reporting methods

Four studies were identified that evaluated different data sources for the outcome of falls such as case notes, electronic incident reporting systems, other general organizational reporting tools, patient self-reports, and dedicated falls evaluation services. The studies assessed whether individual methods provided an advantage over other methods. Most studies showed differences based on the source used to evaluate falls. The selection of reporting methods is an important aspect of fall prevention evaluations.

Other tools used in falls prevention

Table 2 includes a small number of other tools that might be of assistance to clinicians when initiating a falls prevention intervention such as the self-efficacy assessment tool for nursing staff.

Potentially relevant tools not specific to falls or falls prevention

We selected reviews and meta-analyses comparing cognitive screening instruments, dementia and delirium assessment tools, and measures of psychological aspects of falls such as self-assessed fear of falling as additional tools potentially useful in the prevention of falls in hospitals. As outlined, domains covered by these specific tools can be an integrated part of fall risk assessment tools, rather than being assessed independently. The final toolkit will address organizational as well as clinical aspects of falls prevention. The tool overview also includes examples for the assessment of the organizational climate such as the readiness for change.

Selection of tools

This overview identified tools for which reliability and validity data exist. In some areas, such as fall risk assessment, clinicians can chose from a large number of tools; in other areas, validated

tools are sparse. In addition, many factors determine whether a tool is chosen in clinical practice. The reliability and validity of the tool should be considered necessary criteria but these are also unlikely to be sufficient criteria. Other relevant aspects are the ease of applicability, integration into clinical practice, and required time and resources.

Conclusion

The evidence review has identified a large number of intervention evaluations, available tools with known measurement properties, and published resources, documented in detail in this report. The identified evidence-based interventions and tools may assist in the development of programs to prevent falls in hospitals. Which tools and interventions are suitable for use in individual hospitals must be evaluated in the context of existing approaches, resources, and individual needs. The identified interventions, tools, and existing resources will be integrated into the AHRQ toolkit as resources to guide fall prevention approaches for hospitals.

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Appendix

Published resources

Web-based Falls Risk Prevention Toolkits and Resources	Description
American Geriatrics Society/British Geriatrics Society Clinical Practice Guideline: Prevention of Falls in Older Persons (2010) Summary of Recommendations http://www.americangeriatrics.org/health_care_professionals/clinical_practice/clinical_guidelines_recommendations/2010/	Downloadable pdfs Intended Users: geriatric physicians in residential care facilities and in the community. Contents: List of recommendations for screening and assessment, and interventions, patient and consumer education materials
American Medical Directors Association Falls and Fall Risk http://www.amda.com/tools/clinical/falls.cfm	Website offering downloadable tools and resources. Intended Users: health care providers and managers. Contents: Clinical practice guidelines, didactic slide presentations, additional resources
Australian Commission on Safety and Quality in Healthcare (2009): Preventing falls and harm from falls in older people: Best practice guidelines for Australian hospitals. Australian Commission on Safety and Quality in Healthcare (2009): Guidebook for Preventing Falls and Harm From Falls in Older People: Australian Hospitals (short version of Preventing Falls) http://www.health.gov.au/internet/safety/publishing.nsf/content/FallsGuidelines-AustHospitals	Website providing materials as pdf files. Intended Users: Providers, consumers, patients, caregivers (targeted materials). Contents: Preventing Falls (for hospitals and providers), Guidebook for Preventing Falls (digest of Preventing Falls for providers/clinicians), Implementation Guide (for hospitals and residential care facilities), additional factsheets and brochures on facts about falls and falls prevention for consumers, patients, caregivers, nurses, allied health professionals (Australian Commission on Safety and Quality in Health Care)
Boushon et al. (2008): Transforming Care at the Bedside How-to Guide: Reducing Patient Injuries from Falls. Institute for Healthcare Improvement/ Robert Wood Johnson Foundation http://www.ihi.org/knowledge/Pages/Tools/TCABHowToGuideReducingPatientInjuriesfromFalls.aspx	Website featuring manual in Word. Intended Users: health care providers. Contents: promising findings and their clinical application, implementation guidelines, implementation case studies, risk reduction tools
Centre for Education & Research on Ageing (CERA) Putting Your Best Foot Forward: Preventing and Managing Falls in Aged Care Facilities (C. Shanley) No date provided http://www.cera.usyd.edu.au/manuals_foot.html	Website offering downloadable pdf manual ($33.00) for assessing and developing care plans for falls and falls prevention, guidelines, resources (Australian Commission on Safety and Quality in Health Care)
Department of Veterans Affairs National Center for Patient Safety (NCPS) Falls Toolkit http://www.patientsafety.gov/SafetyTopics/fallstoolkit/index.html	Website providing program implementation materials, media tools, resources, materials in Word, pdf, Powerpoint. Intended Users: Patient safety managers, other members of interdisciplinary team. Contents: information on forming falls program, program materials (posters, flyers, brochures, buttons, video, etc.), risk assessment tools, prevention interventions, specific information on use of hip protectors, outcome assessments
Dignity in Care Network	Website providing resources on treating

Web-based Falls Risk Prevention Toolkits and Resources	Description
http://www.dignityincare.org.uk/	patients with dignity and respect (UK)
ECRI Institute: INsight™ Web-based Risk Assessment for Falls Prevention https://www.ecri.org/Products/Pages/insight_web_based_risk_assessment_for_falls_prevention.aspx	Web-based survey tool. Intended Users: Employers and health care organizations. Contents: Risk assessment survey that generates reports to enable policy development, resource allocation, forecasting, and priority setting
ECRI Healthcare Risk Control, Risk Analysis Falls Volume 2, September 2005 https://www.ecri.org/Documents/Patient_Safety_Center/Falls.pdf	ECRI report on falls risk analysis, includes risk assessment tool
Fall TIPS (Tailoring Interventions for Patient Safety) / Fall T.I.P.S. http://www.brighamandwomens.org/Patients_Visitors/pcs/nursing/nursinged/Falls3ToolKit.aspx	Website provides downloadable tools. Intended Users: health care providers. Contents: Fall TIPS Toolkit, tools under development, Morse Fall Scale manual, falls prevention scales, link to manuscript describing use, falls prevention behavior scales for nurses and assistants
Gray-Micelli D. Preventing falls in acute care. In: Capezuti E et al., (editors) *Evidence-based Geriatric Nursing Protocols for Best Practice*, 3rd edition NY: Springer Publishing Co. pp 161-98 http://www.guideline.gov/content.aspx?id=12265	Downloadable summary of guidelines, Nursing Care Strategies, Interventions to Decrease the Risk for Falls, Assessment Parameters, Follow-up Monitoring, definitions
Grout J. Mistake-proofing the design of health care processes. (Prepared under an IPA with Berry College). AHRQ Publication No. 07-0020. Rockville MD: AHRQ; May 2007. http://www.ahrq.gov/qual/mistakeproof/mistakeproofing.pdf	General report and approach outline on patient safety with many visual examples and algorithm for mistake-proof design
Institute for Clinical Systems Improvement. Health Care Protocol: Prevention of Falls (Acute Care) http://www.icsi.org/falls__acute_care___prevention_of__protocol_/falls__acute_care___prevention_of__protocol__24255.html	Online PDF outlining a health care protocol designed to assist clinicians by providing an analytical framework (algorithm) for risk assessment for falls in hospitalized patients and strategies and interventions required for the prevention of falls
Joint Commission International. Joint Commission Resources: "It's A Long Way Down: Reducing the Risk of Patient Falls" (Web-based training/Continuing Education) http://www.jcrinc.com/Web-Based-Education/Its-A-Long-Way-Down-Reducing-The-Risk-of-Patient-Falls/890/ or http://www.jointcommissioninternational.org/Web-Based-Education/Its-A-Long-Way-Down-Reducing-The-Risk-of-Patient-Falls/1435	Website featuring downloadable for-purchase falls prevention education program (videos and pdfs) for a fee ($199). CE credit available on completion. Intended Users: health care professionals
Lyons SS Fall Prevention for Older Adults Evidence-Based Guideline. The University of Iowa Gerontological Nursing Interventions Research Center. Research Translation and Dissemination Core. (2004) http://www.nursing.uiowa.edu/centers/gnirc/RDC%20Order%20Sheet1.pdf)	Comprehensive guideline and review of factors associated with increased fall risk; provides several tools and contact resources
Massachusetts Falls Prevention Coalition http://www.maseniorcarefoundation.org/Initiatives/Falls_Preventio	A coalition of more than 75 organizations in MA, including health care institutions,

Web-based Falls Risk Prevention Toolkits and Resources	Description
n/Massachusetts_Falls_Prevention_Coalition.aspx	government agencies, advocates, researchers, community-based senior care agencies dedicated to promoting legislation, disseminating research findings, conducting educational programs, and working on quality improvement initiatives. Website provides links to resources.
Minnesota Hospital Association Patient Safety Call to Action, Road Map to a Comprehensive Falls Prevention Program, 2007 http://www.mnhospitals.org/inc/data/tools/Safe-from-Falls-Toolkit/falls-prevention-roadmap.pdf	Pdf of "Road Map". Intended Users: health care providers. Contents: pdf describing program infrastructure and patient care bundle
National Council on Aging: Fall prevention http://www.healthyagingprograms.org/content.asp?sectionid=149	Website presenting printable pdfs and Word files. Intended Users: Health care providers, social service organizations, "partner organizations". Contents: materials and resources to publicize and organize activities around Falls Prevention Awareness Day
National Health Service/National Institute for Clinical Excellence NICE Clinical Guideline on Falls and Quick Reference Guide: Falls: the assessment and prevention of falls in older people Clinical Guideline 21, November 2004 http://www.nice.org.uk/CG021	Downloadable pdf files. Intended Users: health care providers, patients. Consumers. Contents: Full guideline, quick reference guide, guide for patients and caregivers
National Institute on Aging: Age Page - Falls and Fractures http://www.nia.nih.gov/HealthInformation/Publications/falls.htm	Website on falls prevention. Intended Users: consumers. Contents: prevention information and links to resources
National Mental Health Development Unit Let's Respect http://www.nmhdu.org.uk/our-work/mhep/later-life/lets-respect/	Website offering downloadable resource materials as a 'toolkit'. Intended Users: healthcare staff who care for older people with mental health needs in acute hospitals (UK)
National Quality Forum: Safe Practice 33: Falls Prevention. Safe Practices for Better Healthcare – 2010 update http://www.qualityforum.org/Projects/Safe_Practices_2010.aspx	Website presenting safe practices. The 2010 update is built on the NQF's original Safe Practices, first endorsed in 2003 then updated in 2006 and 2009
Patient Safety First (2009): The 'How to' guide for reducing harm from falls http://www.patientsafetyfirst.nhs.uk/Content.aspx?path=/Campaign-news/current/Howtoguidefalls/	Website featuring pdf manual. Intended Users: hospital managers and care providers. Contents: Improvement model includes risk assessment, prevention information, after falls care information, training materials, model individual falls care plan, tool to assess effectiveness of falls prediction tools. (UK)
Partnership for Patient Care (Health Care Improvement Foundation. ECRI/Delaware Valley Healthcare Council/Independence Blue Cross) (2007). Failure Mode and Effects Analysis (FMEA): Falls Prevention https://www.ecri.org/Documents/Patient_Safety_Center/PPC_Falls_Prevention.pdf	Manual on using Failure Mode and Effects Analysis to analyze the potential barriers to implementation of processes to prevent falls, possible causes, effects, and mitigation strategies. Assessment toolkit provided, including process flow chart, FMEA worksheet, and 4 case studies illustrating the analytic process

Web-based Falls Risk Prevention Toolkits and Resources	Description
Premier, Inc. (2011): Falls Prevention http://www.premierinc.com/all/safety/resources/falls/ Premier is a nationwide alliance of approximately 200 hospitals and health care organizations aimed at improving local health care	Website providing printable or emailable pages. Intended Users: health care providers. Contents: Summary of the Issues; prevalence, definitions and measurement, prevention strategies, risk assessment, comprehensive programs, education and training resources (downloadable factsheets and links to other resources, guidelines, organizations)
Prevention of Falls Network Earth (ProFaNE) http://profane.co/	Online community of health care professionals dedicated to falls prevention. Contents: news, updates, and resources
Registered nurses association of Ontario (2005): Prevention of Falls and Fall Injuries in the Older Adult. Nursing best practice 'How to' guidelines http://www.rnao.org/Page.asp?PageID=924&ContentID=810	Website providing printable or downloadable pdf and word pages. Intended Users: nurses, other allied health professionals. Contents: "Self-learning package" that contains best practices and standards, assessment tools, planning and implementation tools, QI tools, additional implementation resources, policies and procedures, care planning, education resources, evaluation, recommended reading
Royal College of Physicians FallSafe Project http://www.rcplondon.ac.uk/resources/closing-gap-fallsafe	Downloadable pdfs for implementing falls prevention programs to identify best practices, includes guidelines on falls risk assessment and prevention and implementation guidelines. Intended users: health care providers, managers. Contents: Information sheet, newsletters, care bundle, guidance notes, assessment form template, drug guide
Satku K. Nursing Clinical Practice Guidelines. Prevention of Falls in Hospitals and Long Term Care Institutions. Ministry of Health, Singapore, December 2005 http://www.hpp.moh.gov.sg/HPP/MungoBlobs/420/970/MOH-Fall%20CPG%20booklet%28printers%20final%29.pdf	Description of MOH Nursing Clinical Practice Guidelines for the prevention of falls in hospitals and long term care institutions
UK Health and Safety Executive: Slips and Trips http://www.hse.gov.uk/slips/	Website offering online and downloadable guidance on workplace safety and falls prevention. Intended Users: employers, architects, workers. Contents: management systems, risk assessment, laws and standards

Notes: All websites accessed in August 2011

Search strategy

PubMed search strategy for interventions studies

"Accidental Falls"[Mesh] OR “fallers”[tiab] OR “falls per”[tiab] OR “falls rate”[tiab] OR “falls incidence”[tiab] OR “falls prevention”[tiab] OR “fall prevention”[tiab] OR “prevention of falls”[tiab] OR "prevent falls”[tiab] OR “prevents falls”[tiab] OR “prevent patient falls”[tiab] OR “prevents patient falls”[tiab] OR “preventing fall”[tiab] OR “preventing falls”[tiab] OR “falls reduction”[tiab] OR “fall reduction”[tiab] OR “reduction of falls”[tiab] OR “reduce falls”[tiab] OR “reduces falls”[tiab] OR “reducing fall”[tiab] OR “reducing falls”[tiab] OR “improve fall”[tiab] OR “improve falls”[tiab] OR “improves fall”[tiab] OR “improves falls”[tiab] OR “improving fall”[tiab] OR “improving falls”[tiab]
AND hospital OR hospitals OR hospitali*
NOT PUBLICATION TYPES “META-ANALYSIS” OR “REVIEW”
All results limited to 2005-8/1/2011 & English only
NUMBER OF RESULTS: 1841

CINAHL search strategy for interventions studies

"Accidental Falls" OR “fallers” OR “falls per” OR “falls rate” OR “falls incidence” OR “falls prevention” OR “fall prevention” OR “prevention of falls” OR "prevent falls” OR “prevents falls” OR “prevent patient falls” OR “prevents patient falls” OR “preventing fall” OR “preventing falls” OR “falls reduction” OR “fall reduction” OR “reduction of falls” OR “reduce falls” OR “reduces falls" OR “reducing fall” OR “reducing falls” OR “improve fall” OR “improve falls” OR “improves fall” OR “improves falls” OR “improving fall” OR “improving falls”
AND
Hospital OR hospitals OR hospitali*
Search modes - Phrase Searching (Boolean)
2005-2011
English
Total before deduping: 876
Date: 8/2011

WEB OF SCIENCE search strategy for intervention studies

Science Citation Index, Social Science Citation Index, Arts & Humanities Index, Conference Proceedings Science Index, Conference Proceedings Social Science Index: 2005-8/5/2011
Topic=("Accidental Falls" OR “fallers” OR “falls per” OR “falls rate” OR “falls incidence” OR “falls prevention” OR “fall prevention” OR “prevention of falls” OR "prevent falls” OR “prevents falls” OR “prevent patient falls” OR “prevents patient falls” OR “preventing fall” OR “preventing falls” OR “falls reduction” OR “fall reduction” OR “reduction of falls” OR “reduce falls” OR “reduces falls" OR “reducing fall” OR “reducing falls” OR “improve fall” OR “improve falls” OR “improves fall” OR “improves falls” OR “improving fall” OR “improving falls”)
AND
Topic=(hospital OR hospitals OR hospitali*)
NUMBER OF RESULTS: 420
NUMBER AFTER REMOVAL OF DUPLICATES: 108

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Barry E, Laffoy M, Matthews E, et al. Preventing accidental falls among older people in long stay units. *Ir Med J*. 2001;94(6):172, 4-6.11495234 A fall prevention programme for older long-stay patients in a 95 bedded District Hospital was undertaken. Data on falls and resulting injuries for the year prior to the intervention were compared with equivalent data after one year (Year 1) and after two years (Year 2) of the intervention. In the pre-intervention year 25% of patients had at least one fall compared with 20.9% and 17.4% in Year 1 and Year 2 respectively. This difference was not statistically significant. However, there were 21% fewer falls in Year 1 and 49.3% fewer in Year 2 than in the pre-intervention year. This difference was significant in Year 2. In both intervention years there was a significant reduction in the incidence of fracture from 20.5% of falls (pre-intervention) to 2.8% in Year 1 and no fractures occurred in Year 2. Significant reductions in soft tissue injuries occurred in Year 2 but not in Year 1, dropping from 38.5% (pre-intervention) to 36.1% and 15.4% respectively. The percentage of patients uninjured after a fall increased from 41% to 61.1% to 84.6%. This intervention reduced falls and their adverse consequences for older people living in the long stay unit. The effect of the intervention escalated in Year 2. The intervention cost IR4,800 pounds. Fall prevention should be part of the routine care of older people in all types of long stay care.
Brady R, Chester FR, Pierce LL, et al. Geriatric falls: prevention strategies for the staff. *J Gerontol Nurs*. 1993;19(9):26-32.8409255 1. Multiple falls and injuries are more prevalent among elderly over the age of 75 and are the second leading cause of accidental death in the elderly. The risk for falling is noted to be significantly greater in the hospitalized elderly. 2. Review of retrospective quality improvement chart audits revealed that peak fall times were associated with the patient's need for toileting, rest, and obtaining nutrition and hydration. 3. The MetroHealth Falls Prevention Program is based on simple proactive measures to prevent falls in the elderly. 4. An effective falls prevention program has several implications

for gerontological nursing practice, including less restraint use, increased patient autonomy, and decreased loss of self-esteem. There is also a sense of increased nursing control over patient safety and time management, as well as implications for further nursing research.

Dyer D, Bouman B, Davey M, et al. An intervention program to reduce falls for adult in-patients following major lower limb amputation. *Healthc Q*. 2008;11(3 Spec No.):117-21.18382172 A qualitative and quantitative assessment was conducted regarding falls sustained by in-patients receiving rehabilitation therapy following major lower limb amputation at the Glenrose Rehabilitation Hospital. During the nine-month assessment period, 18 of 58 patients in the amputee unit experienced a fall, of which 17% resulted in a moderate injury. The majority of falls occurred during patients' use of a wheelchair (14 of 18) and involved poor balance (nine of 14). Patient wheelchair self-transfers accounted for 71% (10 of 14) of the falls, while sitting in the wheelchair and reaching represented 29/ (four of 14). The hospital's rehabilitation program teaches patient safety including using assistive devices such as wheelchairs but did not include a comprehensive graded learning path to monitor patients' ongoing risk for falls. Based upon the data collected, an intervention program was initiated to improve patient safety and reduce the number of falls. The multidisciplinary program encompassed aspects ranging from an environmental assessment of the patients' room to medication management, continuous patient wheelchair skills training and alteration of the care plan. The effectiveness of the intervention program was assessed through a series of interviews and questionnaires administered to medical personnel. This article presents the preliminary data collected during the first three months of the six-month study. Overall, satisfaction has significantly improved as a direct result of the intervention program. The article provides evidence-based interventions that improve safety for a subset of in-patients known to be susceptible to falls when using wheelchairs. Other in-patient groups will also benefit from these findings as many are universally applicable.

Grenier-Sennelier C, Lombard I, Jeny-Loeper C, et al. Designing adverse event prevention programs using quality management methods: the case of falls in hospital. *Int J Qual Health Care*. 2002;14(5):419-26.12389808 OBJECTIVE: From a public health perspective, the effectiveness of any prevention program depends on integrated medical and managerial strategies. In this way, quality management methods drawn from organization and business management can help design prevention programs. The aim of this study was to analyze the potential value of these methods in the specific context of preventing falls in hospital. SETTING: Medical and Rehabilitation Care Unit of Saint-Maurice National Hospital (France). DESIGN: In phase 1, two surveys assessed the context in which falls occurred. The first survey (1995) quantified adverse events during a 1-year period (n = 564) and the second (1996-1997) documented the reasons for falls (n = 53). In phase 2, a set of recommendations to prevent falls was elaborated and implemented throughout the hospital. RESULTS: The fall frequency in this unit was 18.3% in 1995. Analysis showed organizational causes in 35 (66%) of the 53 documented falls; 24 of them were associated with individual factors. Even though the two categories of causes are interdependent, their distinction enables specific recommendations. The proposed organizational management changes recommended do not aim to achieve an illusory objective of 'zero falls', but are designed to reduce the number of avoidable falls and to limit the negative consequences of unavoidable falls. CONCLUSION: Quality improvement methods shed new light on how to prevent falls. An unexploited potential for prevention lies in organization and management of care for hospitalized patients.

Haines TP, Bennell KL, Osborne RH, et al. Effectiveness of targeted falls prevention programme in subacute hospital setting: randomised controlled trial. *BMJ*. 2004;328(7441):676.15031238 Tool shown OBJECTIVE: To assess the effectiveness of a targeted, multiple intervention falls prevention programme in reducing falls and injuries related to falls in a subacute hospital. DESIGN: Randomised controlled trial of a targeted multiple intervention programme implemented in addition to usual care compared with usual care alone. SETTING: Three subacute wards in a metropolitan hospital specialising in rehabilitation and care of elderly patients. PARTICIPANTS: 626 men and women aged 38 to 99 years (average 80 years) were recruited from consecutive admissions to subacute hospital wards. INTERVENTION: Falls risk alert card with information brochure, exercise programme, education programme, and hip protectors. MAIN OUTCOME MEASURES: Incidence rate of falls, injuries related to falls, and proportion of participants who experienced one or more falls during their stay in hospital. RESULTS: Participants in the intervention group (n = 310) experienced 30% fewer falls than participants in the control group (n = 316). This difference was significant (Peto log rank test P = 0.045) and was most obvious after 45 days of observation. In the intervention group there was a trend for a reduction in the proportion of participants who experienced falls (relative risk 0.78, 95% confidence interval 0.56 to 1.06) and 28% fewer falls resulted in injury (log rank test P = 0.20). CONCLUSIONS: A targeted multiple intervention falls prevention programme reduces

the incidence of falls in the subacute hospital setting.

Mayo NE, Gloutney L, Levy AR. A randomized trial of identification bracelets to prevent falls among patients in a rehabilitation hospital. *Arch Phys Med Rehabil*. 1994;75(12):1302-8.7993168 This purpose of this study was to determine whether an identification bracelet is effective in preventing falls among high-risk patients who are undergoing in-patient physical rehabilitation. A stratified, randomized, balanced controlled clinical trial was conducted; participants were blinded as to the outcome and the study hypothesis. All patients having one or more risk factors that predisposed them to falls were randomized to receive either a blue identification bracelet or no bracelet. The identification bracelet was intended to increase patients' vigilance about falling. Two risk strata were specified. The high risk stratum consisted of patients with stroke or ataxia, urinary incontinence, or a history of falls. The low risk stratum comprised patients older than 80 years and those on one or more medications that had been identified as contributing to an individual's risk of falling. This report presents the effect of the identification bracelet only among persons in the high-risk stratum. Over 1 year, 65 high-risk subjects were randomized to receive the blue identification bracelet and 69 high-risk subjects were controls. In the intervention group, 27 persons (41%) fell at least once, whereas in the control group 21 persons (30%) fell at least once yielding a hazard ratio of 1.3 (95% confidence interval: 0.8 to 2.4). These results suggest that the identification system was of no benefit in preventing falls among high-risk persons.

Rogers S. Reducing falls in a rehabilitation setting: a safer environment through team effort. *Rehabil Nurs*. 1994;19(5):274-6.7855391 A 2-year falls prevention project has included a concurrent analysis of all falls and a program to prevent falls in a 160-bed rehabilitation hospital. The program has been designed on the basis of the data collected. A consistent follow-up program involves patients and staff in the continuous monitoring of patient safety.

Saleh BS, Nusair H, Al Zubadi N, et al. The nursing rounds system: Effect of patient's call light use, bed sores, fall and satisfaction level. *International Journal of Nursing Practice*. 2011;17(3):299-303.2011061169 Saleh BS, Nusair H, Zubadi NAL, Al Shloul S, Saleh U. International Journal of Nursing Practice 2011; : 299-303 The nursing round system (NRS) means checking patients on an hourly basis during the A (0700-2200 h) shift and once every 2 h during the B (2200-0700 h) by the assigned nursing staff. The overall goal of this prospective study is to implement an NRS in a major rehabilitation centre-Sultan Bin Abdulaziz Humanitarian City-in the Riyadh area of the Kingdom of Saudi Arabia. The purposes of this study are to measure the effect of the NRS on: (i) the use of patient call light; (ii) the number of incidences of patients' fall; (iii) the number of incidences of hospital-acquired bed sores; and (iv) the level of patients' satisfaction. All patients hospitalized in the male stroke unit will be involved in this study. For the period of 8 weeks (17 December 2009-17 February 2010) All Nursing staff on the unit will record each call light and the patient's need. Implementation of the NRS would start on 18 February 2010 and last for 8 weeks, until 18 April 2010. Data collected throughout this period will be compared with data collected during the 8 weeks period immediately preceding the implementation of the NRS (17 December 2009-17 February 2010) in order to measure the impact of the call light use. The following information were collected on all subjects involved in the study: (i) the Demographic Information Form; (ii) authors' developed NRS Audit Form; (iii) Patient Call Light Audit Form; (iv) Patient Fall Audit Record; (v) Hospital-Acquired Bed Sores Audit Form; and (vi) hospital developed Patient Satisfaction Records. The findings suggested that a significant reduction on the use of call bell ($P < 0.001$), a significant reduction of fall incidence ($P < 0.01$) while pressure ulcer reduced by 50% before and after the implementation of NRS. Also, the implementation of NRS increased patient satisfaction by 7/5 ($P < 0.05$).

Savage T, Matheis-Kraft C. Fall occurrence in a geriatric psychiatry setting before and after a fall prevention program. *J Gerontol Nurs*. 2001;27(10):49-53.11820378 A fall prevention program providing staff education, quantitative assessment of gait and balance, risk factors assessment, and evidence-based interventions was introduced on two geriatric wards of a regional psychiatric hospital. A within-subjects comparison was made of fall occurrence during the 4-month pre-intervention phase and the 4-month post-intervention phase using Fisher's exact test. Among those ($N = 23$) who survived the duration of the study, significantly fewer falls occurred in the post-intervention time period than in the pre-intervention time period ($p < 0.01$). Comprehensive assessment, problem identification, and intervention planning by nurses may serve to reduce the number of falls among elderly individuals with severe psychiatric disorders.

Uden G, Ehnfors M, Sjostrom K. Use of initial risk assessment and recording as the main nursing intervention in identifying risk of falls. *J Adv Nurs*. 1999;29(1):145-52.10064293 The consequences of falls among hospital patients are a great problem, for the patient, the family and society, and cost billions of dollars. In Sweden, almost one-third of all hip fractures occur in the hospital population. Despite this, very few

prevention strategies have been developed and tested. In this study, a risk assessment and recording programme in relation to the risk of falling among patients in a geriatric department at a Swedish hospital was implemented. The records of all patients admitted to a geriatric unit during one year, and a stratified random sample of patient records, constituting the control group from the year before, were reviewed. No recording of assessments regarding the patients' risk of falling, and no preventive nursing interventions, were found in the records of the control group. The study group, however, increased the recording of risk assessment to 96%. Only implemented nursing interventions were found in the patients' records, despite the fact that Swedish law makes it obligatory for the registered nurse to record both the planning and implementation of nursing care. In the study group there were explicit descriptions of problems of concern for nursing regarding the patients' risk of falling in less than one-third of the records, the nursing care plans were rare, and the evaluations were not satisfactory. Nursing interventions consisted mostly of information or education, promotion of patient participation, and structuring of the environment. There was no agreement on any standard-care plan. Recording of falls was found more often in the study group than in the control group (probably due to more careful recording), but the proportion of injuries in relation to falls was higher in the control group. The results of this study may be used as a baseline for developing a nursing strategy and documentation relating to falls.

Vassallo M, Vignaraja R, Sharma JC, et al. The effect of changing practice on fall prevention in a rehabilitative hospital: the Hospital Injury Prevention Study. *J Am Geriatr Soc*. 2004;52(3):335-9.14962145 OBJECTIVES: To determine whether a change in practice to introduce a multidisciplinary fall-prevention program can reduce falls and injury in nonacute patients in a rehabilitation hospital. DESIGN: A quasi-experimental study. SETTING: Three geriatric wards with a similar design, equipment, staffing levels, and skill mix. PARTICIPANTS: Eight hundred twenty-five consecutive patients. INTERVENTION: The patients' fall-risk status was assessed using the Downton Score. Current practice was maintained on the two control wards (n=550). On the experimental ward (n=275), a fall-prevention program was introduced. A multidisciplinary team met weekly specifically to discuss patients' fall risk and formulate a targeted plan. Patients at risk were identified using wristbands; risk factors were corrected or environmental changes made to enhance safety. MEASUREMENTS: Primary outcomes were number of fallers, recurrent fallers, total falls, patients sustaining injury, and falls per occupied bed days. Secondary outcomes were place of discharge and mortality. RESULTS: Patients were matched for age and risk status. Control wards had proportionally more fallers (20.2% vs 14.2%: P=.033), patients sustaining injury (8.2% vs 4%: P=.025), and total number of falls (170 vs 72: P=.045). These results did not remain significant after controlling for differing length of stay. There was no reduction in recurrent fallers (6.4% vs 4.7%: P=.43) and no effect on place of discharge (home discharges; 57.5% vs 60.7%: P=.41) or mortality (15.3% vs 13.8%: P=.60). CONCLUSION: This study shows that falls might be reduced in a multidisciplinary fall-prevention program, but the results are not definitive because of the borderline significance achieved and the variable length of stay. More research on fall prevention in hospital is required, particularly as to what interventions, if any, are effective at reducing falls in this group of patients.

References of included tool evaluations (Evidence table 2)

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Other example tools and interventions

Example tools shown in full in the publication. Note: Publications do not meet inclusion criteria for intervention evaluations (Evidence table 1) or tool evaluations (Evidence table 2) **Reference**	**Publication description and shown tool**
Barbieri EB (1983) Patient Falls Are Not Patient Accidents. Journal of Gerontological Nursing Vol. 9, No. 3 pp 165-173.	Study description aimed at identifying patients at high risk for falling, includes post-fall patient assessment, tool printable from article
Close JCT and SR Lord. (2011) Fall assessment in older people. BMJ Vol. 343, pp 579-82.	Article provides case scenarios, links to a video on conducting a falls assessment, a list of validated tests and tools, assessments and interventions linked to various risk factors, and links to additional practice improvement resources
Coles et al., (2005) Using Failure Mode Effects and Criticality Analysis for High-Risk Processes at Three Community Hospitals, Joint Commission Journal on Quality and Patient SafetyVol. 31, No. 3	Report of use of failure mode analysis to develop a system process for a patient falls prevention program, flow diagram shown
Cooper CL and JD Nolt (2007) Development of an Evidence-based Pediatric Fall Prevention Program. J Nurs	Evidence review, provides falls assessment form and flow diagram for designing and implementing

Care Qual Vol. 22 No. 2, pp 107-12.	an evidence-based falls prevention program
Corbett C, Pennypacker B. Using a quality improvement team to reduce patient falls. *J Healthc Qual*. 1992;14(5):38-41, 4-54.10120429	Report describing a quality improvement team process, provides tools for assessing the admission risk factors, shift assessment, a process report and other resources
Fenton W. (2008) Introducing a post-fall assessment algorithm into a community rehabilitation hospital for older adults. Nursing Older People vol. 20 No. 10 pp 36-39.	Report of the development of a post-fall assessment algorithm, provides the algorithm and a Post-fall Assessment Algorithm Form
Fink N et al., (2010) Developing a Usability Evaluation tool to Assess the Patient Room Bathroom. (HERD) Journal Vol. 3, No. 3, pp 22-41.	Report of the development of a heuristic evaluation tool to assess the risk for falls likely to be associated with a particular design for a hospital bathroom, which would allow redesign prior to final construction, provides Bathroom Heuristic Evaluation Tool
Gordon B, et al. (2010): Post-fall decision tree development and implementation. Journal of Nursing Care Quality. October/December 2010 - Volume 25 - Issue 4 - p 358–365 PMID: 20802278	Description of a process to develop post-fall decision guidelines, provides the decision algorithm, EXIT plan (leave patients with Equipment in reach, eXtreme needs met, Intervention for pain management, Take note of hazards), Fall Intervention Order Set, Postfall huddle form
Hayes N. Prevention of falls among older patients in the hospital environment. *Br J Nurs*. 2004;13(15):896-901.15365499	Evidence review, provides STRATIFY tool and an individualized falls action plan
Hendrich A (2007) Predicting Patient Falls: Using the Hendrich II Fall Risk Model in clinical practice. AJN Vol. 107, No. 11, pp 50-58	Report that describes the development of the Hendrich II assessment tool, provides link to video, and includes the tool with instructions for use and interpretation
Hill et al., 1988. Reducing the Incidence of Falls in High Risk Patients, Journal of Nursing Administration Vol. 18, No. 7,8	Report that describes the development of an integrated, computerized fall risk assessment, diagnosis, and interventions, tool shown
Lee PS, Pash BJ. Preventing patient falls. *Nursing*. 1983;13(2):118-20.6549781	Report describing a strategy to prevent patient falls, includes a checklist for preventing falls
Lyons S et al., (2005) Evidence-based Protocol: Falls Prevention for Older Adults Journal of Gerontological Nursing, November 2005 Pp9-14 PMID: 16320431	Evidence review on falls risk assessment and prevention for nurses, provides Gait & Balance Screening, elements of a comprehensive risk assessment, and Quality Improvement Monitor
McCarter-Bayer A, et al., (2005) Preventing Falls in Acute Care: An Innovative Approach. Journal of Gerontological Nursing March 2005 pp 25-33.	Description of an individualized falls prevention strategy, provides Quality Improvement Data Collection Tool
National Database of Nursing Quality Indicators. Guidelines for Data Collection on the American Nurses Association's national Quality Forum Endorsed Measures: Nursing Care Hours per Patient Day, Skill Mix, Falls, Falls with Injury	Indicator set includes Patient Falls Indicator for measuring patient fall rates, determining frequency with which patient falls result in injury, and exploring relationship of falls with nurse assessments and interventions
Poe SJ et al., (2005) An Evidence-based Approach to Fall Risk Assessment, Prevention, and Management – Lessons Learned. J Nurs Care Qual vol. 20 No. 2 pp107-116.	Description of a falls prevention initiative provides a Fall Risk Assessment Tool and falls prevention strategies according to risk
Quigley et al. (2007) Measuring Fall Program Outcomes. The Online Journal of Issues in Nursing Vol. 12, No. 2.	Descriptions of exemplary falls prevention programs, provides Fall Data and Communication Tracking Sheet and examples of control charts
Ryu YM (2009) Patient and Family Education for Fall Prevention. J Nurs Care Qual Vol. 24, No. 3, pp 243-249.	Description of an educational intervention for falls prevention on an inpatient neuroscience unit, provides an educational poster
Spellbring AM, Gannon ME, Kleckner T, et al. Improving	Pilot study describing the use of several different

safety for hospitalized elderly. *J Gerontol Nurs*. 1988;14(2):31-7.3343489	tools, provides assessment for high risks to falls, Assessment and interventions for patients at risk to falls form, Falls precautions check list prevention and intervention, and Safety Alert Sticker design
Tzeng H-M and C-Y Yin. (2010). Adding additional grab bars as a possible strategy for safer hospital stays. Applied Nursing Research Vol. 23, pp 45-51.	Non-systematic review of the use of grab bars to prevent falls in hospitals, provides recommended specifications for grab-bars and hand-rails
Wood L, Cunningham G. (1992). Fall risk protocol and nursing care plan. *Geriatr Nurs*;13(4):205-6.1323516	Description of a nursing care plan (shown in full) to help identify patients and care for patients who are at risk for falls during hospitalization