Falls in Acute Hospitals

A Systematic Review

David Evans, Brent Hodgkinson, Leonnie Lambert, Jacky Wood and Inge Kowanko

This systematic review was conducted by The Joanna Briggs Institute for Evidence Based Nursing and Midwifery - (Adelaide), in conjunction with the Royal Adelaide Hospital, Adelaide, South Australia.

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This systematic review was conducted under the guidance of a panel of experts who acted as consultants during the review process. The review panel members were:

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Objectives

The objective of this review was to present the best available information for the effectiveness of interventions designed to reduce the incidence of falls in patients during hospitalisation. The review also provides a narrative summary of the characteristics of patients who fall, major hospital environmental factors that contribute to falls, and interventions that are currently employed or being trialed.

Inclusion Criteria

Types of Participants

Adult patients in acute care hospitals or other similar institutions.

Types of Intervention

Interventions which assessed the risk of falling in adult hospital patients or other interventions used to minimise the risk of falling in adult hospital patients.

Types of Outcome Measures

Outcome measure of interest was the number of patient falls during hospitalisation.

Types of Studies

This review considered any randomised or quasi-randomised controlled trials that addressed the effectiveness of risk assessment or other interventions that minimised the number of falls. In addition to this, studies using other research methods were assessed for inclusion in the review as part of the narrative summary.

Search Strategy

The search sought to identify both published and unpublished studies, and utilised a range of electronic databases using accepted search techniques, and included CINAHL, MEDLINE, Embase, Current Contents, Cochrane Library and Psychlit.

Assessment of Quality

Methodological quality of RCT were assessed by two reviewers using a developed checklist. All studies were categorised according to the strength of the evidence using a published scale.

Data Collection and Analysis

Randomised controlled trial research design was rarely used in identified studies and therefore statistical techniques were not used to combine studies. Evidence was synthesised by brief narrative summaries, or in some cases by listing significant information.

Results

Based on the abstract or title, 194 were papers were retrieved, of which 100 met the inclusion criteria and are cited in this report. Four unpublished reports were identified. Of the 100 papers, there were only two RCT that met the inclusion criteria.

Increased Risk of Falling

A large number of studies have addressed risk factors associated with patient falls, but many had potential sources of error because of the study design utilised, or their conduct. Commonly identified risk factors for falling identified by case control or cohort studies include; age, mental status, history of falls, medications, toileting needs and poor mobility. Most falls were reported to have occurred at the patient's bedside. Transferring from bed or chair was the most frequently identified patient activity at the time of the fall.

Assessment of Risk

Screening tools aim to provide early detection of problems and to allow interventions aimed at preventing falls to be initiated. No one risk assessment tool can be recommended, and the usefulness of these assessment tools in clinical practice has yet to be demonstrated.

Fall Prevention Interventions

Two small RCT evaluated fall prevention interventions in the acute hospital setting but neither demonstrate a beneficial effect when using pressure alarms or identification wrist bracelets. While many other studies were identified that attempted to evaluate fall prevention interventions, their usefulness is limited because of issues such as small sample size, research design, and quality. The most common approach taken to prevent patient falls has been the use of multiple interventions aimed at minimising the risks associated with falling. Results of studies are contradictory and the effectiveness of this approach has yet to be demonstrated.

Implications for Practice

This review has identified patient characteristics and activities associated with an increased risk of falling, and these should be the focus of any fall prevention programme. While some form of assessment of patients for risk of falling will likely help determine when special prevention interventions are needed, there is currently little evidence to support the use of fall risk assessment tools. There is nothing to suggest that the use of a generic assessment tool, identified from the literature, offers greater accuracy than tools developed by institutions based on local patient characteristics.

This review summarised the common approaches to fall prevention utilised by researchers as an indication of expert opinion. This expert opinion suggests that institutions should have a falls prevention programme consisting of multiple interventions aimed at minimising individual patient's risk of falling. While the use of multiple fall prevention interventions was the most common approach, results of its effectiveness are contradictory. Currently, no interventions have been proven to be effective in fall prevention in the acute care setting.

Introduction

It has been estimated that one third of people aged over 65 years suffer at least one fall per year. In Australian hospitals, 38% of all reported patient incidents involve a fall [1]. The approach to fall prevention to date has been inconsistent. The high incidence of falls has been attributed to many factors including trauma, debilitating disease, environmental hazards, age, mental status, length of hospital stay and gender. A preliminary search of the literature identified systematic reviews on fall prevention with a focus on the elderly [2], institutionalised elderly [3], and on falls in the community [4]. No systematic review was identified on fall prevention research related to patients in acute care hospitals. This preliminary search also suggested that there were few randomised controlled trials related to falls in acute hospital patients, with descriptive research methodologies the most commonly utilised method. The focus of previous research has been the identification of risk factors associated with patient falls, the assessment of a patient's risk of falling, and interventions aimed at preventing patient falls.

It was proposed that falls occurring in acute care hospitals were the result of different factors and circumstances than falls occurring in the community or long term care facilities, and therefore previous research in these other settings was of limited value. This systematic review was undertaken to summarise all previous research related to falls in the hospital setting.

The systematic review method was based on the work of Cochrane Collaboration [5] and Centre for Reviews and Dissemination at The University of York [6].

Objectives

The objective of this review was to present the best available information for the effectiveness of interventions designed to reduce the incidence of falls in patients during hospitalisation. The review aimed to summarise the findings of all relevant studies relating to these interventions.

The specific hypotheses tested were:

- Assessment of patients for risk of falling while in hospital reduces the number of falls.
- Interventions that minimise the risk of hospital patients falling reduce the number of falls.

In addition to this analysis of findings related to risk assessment and interventions to minimise falls, this review aimed to provide a narrative summary of:

- Most common characteristics of patients who fall.
- Major hospital environmental factors and patient activities associated with falls.
- Interventions to minimise falls that are currently employed or being trialed in hospitals.

Inclusion Criteria

Inclusion criteria were used to determine which studies would be included in the review, and to be included, studies were required to meet all criteria.

Types of Participants
Trials which included adult patients in acute care hospitals or other similar institutions such as rehabilitation hospitals. This review excluded studies whose participants are long term residents of nursing homes or community centres.

Types of Intervention
This review included interventions which assessed the risk of falling in adult hospital patients or other interventions used to minimise the risk of falling in adult hospital patients.

Types of Outcome Measures
Outcome measure of interest was the number of patient falls during hospitalisation.

Types of Studies
This review considered any randomised or quasi-randomised controlled trials (RCT) that addressed the effectiveness of risk assessment or other interventions that minimised the number of falls. Studies using other research methods were assessed for inclusion in the review as part of the narrative summary.

Search Strategy

The search sought to identify both published and unpublished studies. The search was limited to English language reports. A two step search method and optimal search strategy as outlined by Dickersin et. al. was used [7]. An initial limited search of MEDLINE and CINAHL databases was undertaken to identify the optimal key words. Database search terms were :

CINAHL

search terms	DESCRIPTOR (fall* or accident*) or TITLE (fall*) or ABSTRACT (fall*)

Medline

#1	6088	RANDOMIZED-CONTROLLED-TRIALS IN PT
#2	2208	RANDOMIZED-CONTROLLED-TRIALS
#3	2106	RANDOM-ALLOCATION
#4	3025	DOUBLE-BLIND-METHOD
#5	258	SINGLE-BLIND-METHOD
#6	8500	#1 or #2 or #3 or #4 or #5
#7	87124	(TG = ANIMAL) not ((TG=HUMAN) and (TG=ANIMAL))
#8	7882	#6 not #7
#9	10522	CLINICAL-TRIAL in PT
#10	4862	explode CLINICAL-TRIALS / ALL SUBHEADINGS
#11	637	(CLIN* near TRIAL*) in TI
#12	1969	(CLIN* near TRIAL*) in AB
#13	3871	(SINGL* or DOUBL* or TREBL* or TRIPL*) near (BLIND* or MASK*)
#14	2907	(#13 in TI) or (#13 in AB)
#15	393	PLACEBOS
#16	463	PLACEBO* in TI
#17	3164	PLACEBO* in AB
#18	1044	RANDOM* in TI
#19	8476	RANDOM in AB
#20	788	RESEARCH-DESIGN
#21	18002	#9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or # 17 or #18 or #19 or #20
#22	87124	(TG = ANIMAL) not ((TG=HUMAN) and (TG=ANIMAL))
#23	16532	#21 not #22
#24	8986	#23 not #8
#25	39830	TG = COMPARATIVE-STUDY
#26	13888	explode EVALUATION-STUDIES / ALL SUBHEADINGS
#27	9338	FOLLOW-UP-STUDIES
#28	5253	PROSPECTIVE-STUDIES
#29	67305	CONTROL* or PROSPECTIVE* or VOLUNTEER*
#30	49958	(#29 in TI) or (#29 in AB)
#31	97801	#25 or #26 or #27 or #28 or #30
#32	87124	(TG = ANIMAL) not ((TG=HUMAN) and (TG=ANIMAL))
#33	72525	#31 not #32
#34	60517	#33 not (#8 or #24)
#35	77385	#8 or #24 or #34
#36	171	(ACCIDENTAL near FALL*) in MeSh
#37	375	FALL* in TI
#38	3192	FALL* in AB
#39	1041	(#38 or # 37 or #36) and #35

Cochrane Library
search term falls

Current Contents
search terms TITLE (fall*) or DESCRIPTOR (fall*)

Embase
search terms DESCRIPTOR
(clin* or trial* or random* or stud* or control*)
and TITLE (fall*) or DESCRIPTOR (fall*)

A second search was conducted to identify all published papers on falls in hospitals, the search terms were:
TITLE (fall*) and DESCRIPTOR (fall* and prevent*)

Psyclit
search terms TITLE (fall*) or ABSTRACT (fall*)

The references of all identified studies and review papers were checked for additional studies.

The search for unpublished studies included:
- Dissertation Abstracts International
- Proceedings

All identified abstracts were assessed by two reviewers and full reports were retrieved for all studies that appeared to meet the inclusion criteria. The studies identified from reference list searching were assessed for initial inclusion on the study title alone.

Assessment of Quality

Methodological quality of RCT was assessed by two reviewers using a checklist based on the work of the Cochrane Collaboration [5] and the Centre for Reviews and Dissemination [6], (see appendix 1). The checklist was pilot tested before use. Disagreements between reviewers were resolved by discussion with a third reviewer. All studies were categorised according to the strength of the evidence using a published scale [8]:

- Level I Evidence obtained from a systematic review of all relevant randomised controlled trials.

- Level II Evidence obtained from at least one properly designed randomised controlled trial.

- Level III.1 Evidence obtained from well designed controlled trials without randomisation.
- Level III.2 Evidence obtained from well designed cohort or case control analytic studies preferably from more than one centre or research group.
- Level III.3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments.
- Level IV Opinion of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Data Collection and Analysis

Randomised controlled trial research design was rarely used in identified studies and therefore statistical techniques were not used to combine studies. Descriptive research method design was the most common method used in studies that focused on fall prevention interventions. While the value of this information is limited because of the threats of bias, this evidence was synthesised by brief narrative summaries, or in some cases by listing significant information.

Results

Based on the abstract or title, 195 papers appeared to meet the inclusion criteria and so were retrieved. Ninety five of these papers did not meet the inclusion criteria or were discussion papers and contained no original data. Of the remaining 100 papers cited in this report, four were unpublished reports and only two were RCT (Appendix II lists all cited studies). The research methods used by the studies cited in this review were:

- randomised controlled trials 2
- non-randomised controlled trials 4
- cohort studies 7
- case control studies 20
- self controlled studies 17
- uncontrolled clinical trials 2
- descriptive studies 44
- other 4

RCT research design was used in only two identified studies and therefore statistical techniques were not used to combine studies. A narrative summary has been used to present the findings of the identified research reports. The aim of this discussion is to summarise the best evidence related to patient falls in acute care hospitals.

The results in this section are presented in the following categories:

1. quality of studies
2. increased risk of falling
3. assessment of risk
4. fall prevention interventions

1. Quality of Studies

In reviewing identified research reports many limitations and sources of error were identified. Poor research design and incomplete reporting of the study method and results, limits the usefulness of many of the papers identified. These issues are summarised below.

Fall Risk Factors

In reviewing the research that attempted to identify factors that increased a patient's risk of falling, many issues related to quality or study design were identified, and include:

- rigorous research design was not utilised in many studies;
- the majority of falls studies were retrospective, using completed incident forms and therefore had no control over completeness or quality of reporting;
- environmental causes of falls were not included in many studies, and this may reflect the retrospective nature of data collection;
- many studies involved reports from only a single centre or institution;
- the time frame of many studies was limited from several months to one year;
- most studies involved only a small number of fallers; and
- reporting of data collection methods and results was often incomplete, making it difficult to determine what research methods were used or what the actual results of the study were.

Risk Assessment

In reviewing the research addressing the assessment of a patient's risk of falling, it was noted that quality of studies were highly variable and include:

- rigorous research design was not commonly utilised in these studies;
- many studies involved only a small number of participants;
- the majority of studies involved reports from only a single centre or institution;
- the reporting of research methods was often inadequate;

- the reporting of results was often incomplete;
- the accepted methods of evaluating the validity and application of screening tools were rarely used.

Fall Prevention Interventions

Only two randomised trials were identified that evaluated single fall prevention interventions in hospital settings. Other studies addressing fall prevention interventions, utilised a variety of research designs, some could perhaps more accurately be termed a practice report rather than research. Issues identified in this group of studies include:

- the majority of studies involved reports from only a single centre or institution;
- the time frame of many studies was limited;
- many studies involved only a small number of participants;
- reporting of research methods was poor, and it was often difficult to determine what was actually done by researchers;
- reporting of results was often incomplete, with some studies failing to give any data;
- rigorous research methods were not commonly used in this group of studies; and
- many reports failed to provide an adequate description of what interventions were used, or how they were implemented.

Because of these potential sources of error and design limitations, the results of these studies must be interpreted carefully. Because of these issues, no specific recommendations can be made.

2. Increased Risk of Falling

This section addresses factors that are associated with an increased risk of patients falling during their hospitalisation. The studies identified predominantly focused on internal causes (patient factors) rather than potential environmental causes of falls.

Patient Risk Factors

This section summarises the characteristics of patients associated with an increased risk of falling. In reviewing studies it was noted that the identified risk factors differed between reports. This difference may be the result of variation in quality between studies, or it may reflect the multifactorial nature of falls. Frequently cited risk factors identified by studies using case control or cohort study designs have been summarised below, and has been classified as level III evidence.

Age

It has been suggested in some studies that age is a significant factor in a patient's risk of falling, with the elderly at greater risk than younger patients [9-11]. Patients 60 to 65 years and older were cited as at high risk of falling [10,11], with the 80 years and older patients being at greatest risk of falling [10]. Contradicting this, some studies have found that age is not a factor that increases a patient's risk of falling [12,13].

The full significance of age as a risk factor is unclear as some case control studies used the patient's age as a characteristic for matching patients for the control group [11,14-18]. For these studies, because age is similar in both case and control groups, its significance can not be determined.

Mental Status

Altered mental status of a patient was the most commonly identified risk factor, with studies suggesting that it significantly increased the risk of falling [9,10,13,14,17,19-23]. The altered mental state of patients cited in these studies, is most commonly reported as confusion or disorientation, but the results of a cohort study suggest that inability to understand and impaired memory may also be significant factors increasing a patient's risk of falling [21].

History of Falls

Studies have cited a history of falls as a significant factor associated with patients being more likely to fall during their hospitalisation [9,13,17,19]. The percentage of fallers who fall more than once that are reported in case

series studies is highly variable. Some studies suggest 16% to 17% of all fallers fall more than once[24,25], 24% of fallers has also been reported[26], 40% of all of patients[27], and 52% of all who fall, falling more than once[28]. The number of times individual patients fall can be high, for example 9[25] and 14 times[29]. This group of patients, that experience multiple falls, have received only minimal attention to date.

Studies have also suggested that many of the fallers repeated the circumstances or characteristics of the first fall in subsequent falls[18,28]. Gaebler found that 58% of multiple fallers repeated the type of fall and 64% repeated the location in subsequent falls[28]. It appears that the number of patients who fall on more than one occasion account for a considerable proportion of the total number of falls.

Medications

Medications have commonly been identified as a significant risk factor for falls[11,15,20-22]. The most commonly cited medications that increase the risk of the patient falling, are those that act on the central nervous system, such as the sedatives and tranquillisers[11,21], benzodiazepines[15] and patients receiving three or more psychoactive drugs[15]. Contradicting these findings, studies have also found little difference in use of medications between fallers and non-fallers[9,14,17,18].

Other medications have been identified by single studies as increasing the risk of falling, including digoxin[15], anti-seizure medications[20], beta blockers, anti coagulants and cardiac medications[13], and the combinations of vitamins and iron, or diuretics and hypotensives[20]. Falls have commonly been attributed to polypharmacy, that is the patient receiving many medications is at greater risk of falling, but this was not identified as a significant risk factor in any case control or cohort study, and one study in a rehabilitation setting found the total number of medications was not a significant factor in patient falls[21]. Diuretics have been identified in descriptive studies as a possible factor contributing to an increased incidence of falls[30,31], however they were not cited as significant in any case control or cohort study.

Mobility

Factors directly or indirectly related to mobility have been identified as being associated with a risk of falling. Identified risk factors include a weak or impaired gait[19,22], weakness[10,13,23], decreased mobility of lower limbs[23], and poor coordination and balance [22]. One study found that patients that fell were more likely to have been using a mobility aid such as walking frame, cane or wheelchair [20]. A study by Morse reviewing multiple fallers identified impaired gait as a significant difference between multiple fallers and non-fallers, and found non fallers had received more fall prevention interventions[18].

Toileting Needs

Special toileting needs, such as needing assistance with toileting, incontinence, or diarrhoea has been cited as a significant risk factor for falling[10,14,17,23]. While diuretics may exacerbate this problem and have been cited in descriptive studies as being associated with increased risk of falling[30,31], they have not been identified as such in case control or cohort studies.

Miscellaneous Factors

In addition to the risk factors already discussed, other factors have been identified as having a significant influence on the patient's risk of falling. Two studies, a case control study[11], and a cohort study[21], identified male patients as being more likely to fall, but this has not been supported in other studies. The full significance of gender as a risk factor is unclear as many case control studies used the patient's gender as one of the characteristics for matching patients for the control group[11,14-18,22]. For these studies, because gender was similar in both case and control groups, its significance can not be determined.

Risk factors identified only in single studies include; intravenous therapy[19], dizziness[10], type of nursing unit[10], substance abuse[23], post-operative conditions[11], admission to an intensive care unit[32], sleeplessness[23] and the length of the patient's hospital stay[21].

There is also some suggestion that factors such as diagnosis, the type of unit, and multiple risk factors may be associated with higher incidence of falls, and these are discussed below.

Diagnosis

The patient's diagnosis[21] and secondary diagnoses[19] may also be associated with increased risk of falling. Specific diagnoses that may be associated with a higher risk of falling include; anaemia, neoplasms, and general medical disease[11], congestive heart failure[15], and cerebrovascular accident[22].

Stroke patients have been singled out as a patient group at greater risk of falling, and this has been supported by a case control study[22], and the fact that the sequelae of stroke such as altered thought processes[9,10,14,17,19,20], and problems with mobility[10,19,22], were commonly identified risk factors in patients who fell. Studies have addressed areas specific to stroke patients. One cohort study identified postural sway, that is the movement of the body during standing, as a significant factor in patient falls[33]. Findings from other studies suggest that impulsive behaviour[34] and response time[35] may also influence the stroke patient's risk of falling.

Type of Units

In reviewing the reports from case series studies, there are suggestions that some care delivery areas experience a higher than normal rate of patient falls. One report in a stroke rehabilitation unit reported that 39% of all patients fell[26], while a geriatric department of an acute care hospital reported a fall rate of 26%[27]. Acute care hospitals have reported fall rates of 1.6%[24], 1.7%[36], and 6%[37]. An unpublished Australian benchmarking study conducted in 5 hospitals found the benchmark range was 5.90 to 17.78 falls per 1000 bed-days[38]. The significance of this is unclear as poor reporting of results in some studies and differences in reporting, make comparison difficult. While acknowledging these limitations, the research suggests that patients in rehabilitation units or geriatric departments of acute hospitals may be at greater risk of falling.

Multiple Risk Factors

While many individual risk factors have been associated with increased risk of falling, one study suggests that patients with more than one risk factor are at higher risk of falling[22].

Other Factors

Other factors, such as location and time of falls, have also been identified in studies and are summarised below. This information is predominantly from the descriptive studies and has been classified as level IV evidence.

In reviewing these studies, it was noted that there is little data available on environmental causes of falls, such as bedside clutter, slippery floors or poor lighting, and this may reflect their retrospective nature of incident reports, which were the primary source of data in this group of studies.

Location of Falls

In reviewing the case series studies that reported the location of falls, most falls occurred in areas which patients commonly frequent. The patient's bed side and ward area is the most commonly identified area for falls[25-27,29,36,39-41]. One unpublished report noted that 43% of all falls occurred from, or near, the patient's bed[38]. Other common locations include the bathroom, toilet and corridors[25,26,29,39,42].

Time of Falls

While it has been suggested that there may be high risk times during the day for patient falls, the findings from studies are contradictory. Some studies cite a single high risk period during the day when falls are most likely to occur[29,43] others list two high risk times, typically early morning and late afternoon[26,27,30,39,41,44]. Specific times cited in studies are highly variable, but it is likely that peak periods for patient falls coincide with peak periods of patient activity, and therefore these periods may differ between hospitals.

Activity at Time of Fall

In reviewing studies to identify high risk activities, the patient transferring from one location to another is the most commonly cited. Transferring into, or out of, bed, and moving about in bed, has been identified in many studies as the patient's activity at the time of the fall[20,44-53]. Transferring in or out of a chair has also been commonly cited in many studies as the activity at the time of the fall[26,41,45-48,50-52,54,55]. Other activities associated with falls include walking[20,26,27,41,45,46,48,49,51,52,54], toileting [20,44,45,47,48,50,52,54,56] and sitting in a chair, commode or wheelchair [26,27,48,55]. One study in a rehabilitation setting found that wheelchairs were involved in 57% of all falls[57].

Length of Stay

In reviewing studies to identify at what stage during a patient's admission are falls most likely to occur, the results are contradictory. The findings from some studies suggest the first week is associated with a higher incidence of falls[11,24,25,43,58], other findings suggest falls are more likely to occur during the later period of hospitalisation[21,55], or that the high risk period is both the early and late periods of hospitalisation[49,53,57]. While the research does not offer explanations for falls occurring in the early or late hospitalisation period, it may be speculated that issues such as an unfamiliar environment, hesitancy in asking for assistance, or weakness following recovery from illness and hospital treatment, could be contributing factors in the time that falls occur.

Floor Surface

There is little information on different types of floor surfaces and the frequency of patient falls. One unpublished report notes that of 22 falls, 17 occurred on vinyl covered floors and 3 on tiled surfaces as found in toilets and bathrooms[37]. This report notes that 17 falls occurred on dry floors and 4 patients fell after slipping in body fluids.

3. Assessment of Risk

One strategy that has been employed to minimise the number of falls in hospital patients, is the use of assessment tools to identify those patients at risk of falling. The rationale for this assessment is that if patients at a high risk of falling can be identified, appropriate interventions can then be instituted to minimise the risks. Studies discussed in this section address the development or testing of risk assessment tools[12,59-67]. This section is based on level III and IV evidence.

Many studies were identified that utilised a program of assessment of risk then implementation of fall prevention interventions. The assessment tools in these studies were typically self developed and were not subject to any form of evaluation, and because of this they are discussed under Fall Prevention Interventions.

The aim of this group of studies was to develop an assessment tool that could be used in different patient care areas and institutions. Most assessment tools utilised a system of scoring the patient's risk of falling, a smaller number simply identified areas of potential risk, where a patient needed additional support. The risk factors used in the different assessment tools varied considerably. The time needed to complete the assessment of a patient ranged from less than 3 minutes[63] to 17 minutes[65]. One small study compared clinical judgement to a risk assessment tool, and concluded that neither could accurately predict risk of falling[61].

Accuracy of Assessment Tools
Five measures are used to determine the accuracy and usefulness of assessment or screening instruments; reliability, sensitivity, specificity, positive predictive value and negative predictive value[68].

Reliability
Reliability is the reproducibility of measurements. For risk assessment tools, interrater reliability is used to measure the reproducibility of results by more than one rater. Interrater reliability of assessment tools was cited in only some of the study reports[61,62,65,67,69], and for most was greater than 90%. This means that assessment tools could generally be used on a patient, by more than one assessor, and produce a similar result.

Sensitivity and Specificity
Sensitivity refers to how well the tool can correctly identify patients at high risk of falling, and specificity is how well the tool can correctly identify patients that are at low risk of falling[70]. Only a small number of studies cited the sensitivity and specificity of the tool[61,62,66,67,69]. The reported sensitivity of tools was variable, ranging from 43% to 95%, while specificity was generally very poor, ranging from 27% to 78%.

Positive and Negative Predictive Value
The positive predictive value is the proportion of patients assessed as being at risk of falling and who experience a fall[68]. The negative predictive value

is the proportion of patients assessed as not at risk of falling who do not fall[68]. While the predictive value of assessment tools has rarely been used in the their evaluation, the few studies that report them[61,67] indicate assessment tools are very inaccurate. Some studies have identified up to 80% of the population as being at risk of falling[66,71], and this therefore limits the usefulness of assessment tools if the plan is to implement fall prevention interventions to only high risk patients.

Other Factors

The outcome used to measure the accuracy of the tools was actual falls by patients. This has limitations as it means the accuracy of assessing patients as "at high risk of falling" is measured only indirectly through actual falls. It is likely that some people at high risk of falling, will not fall during their hospitalisation period. Therefore using falls as the indicator of accuracy of assessment tools brings with it these limitations.

Assessment tools measure patient factors that increase their risk of falling. Environmental factors that could impact on a patients risk of falling, such as staffing levels or changes in patient occupancy, are not measured by assessment tools. It was also noted that an effective screening programme is useful only if there is also an effective treatment or intervention available for patients identified as "at risk". As fall prevention interventions have not been adequately described or evaluated, risk assessment tools are currently of limited value. Assessment tools may have a role in raising staff awareness of the risk of patients falling, but this has not yet been demonstrated.

Many studies utilised fall prevention interventions during the development or testing of assessment tools[67,71-73]. These interventions impact on interpretation of the studies findings from two perspectives. Firstly, because interventions are applied to only some of the participants, it may be that it is the fall prevention interventions that determine the outcome independently of the risk assessment. Secondly, because only some of the participants have received fall prevention interventions, it is difficult to then accurately compare the patients assessed as "at risk of falling" to the "not at risk of falling" group.

The application of falls risk assessment tools to clinical practice, and their effectiveness, need further study utilising rigorous research techniques. The usefulness of these risk assessment tools in clinical practice have yet to be demonstrated. Falls risk assessment tools are very inaccurate, in that they identify a large proportion of the patient population as being at risk of falling, which limits the tools' clinical usefulness. There is currently no evidence to suggest that the generic risk assessment tools identified in the literature, offer any additional benefits over tools that are used within a single institution and have been developed based on that population's characteristics. While some form of assessment will be required to determine when fall prevention interventions should be provided to patients, on the basis of the current research, no particular risk assessment tool can be recommended.

4. Fall Prevention Interventions

The final area of this review was that of interventions aimed at preventing patient falls. Fall prevention interventions is currently the most poorly researched area of this topic. Only two RCT were identified during the search, Tideiksaar *et al.*[74] evaluated the effectiveness of a pressure sensitive alarm and Mayo *et al*[75] evaluated the effectiveness of identification bracelets in a rehabilitation hospital. Because of the lack of rigorous studies, the results have been classified as level IV evidence (expert opinion). This section presents a discussion of interventions being tested, or currently part of clinical practice, and summarises the current approach to fall prevention.

Alarm Systems

Tideiksaar *et al.*[74] evaluated the effectiveness of a bed alarm system in an acute care setting. This system consisted of a pressure sensitive pad placed on top of the patient's mattress. While this study failed to show any benefits when using this system, as it involved only 35 patients in each group and a total of 5 falls it is unlikely that this size study would show any effect. One uncontrolled trial evaluated ambularms over a one month period[76]. Ambularms are attached to the patient's leg and alarm if the leg is shifted from the horizontal position to a dependent angle of 45 degrees. While the use of this system reduced the number of patient falls, because of the study's limited size and research method, the effectiveness of ambularms can not be determined.

Fall alarm systems have also been evaluated as part of a program utilising a variety of fall prevention interventions[62,77-79]. While some studies report a reduction in the number of falls as a result of the interventions, these results must be interpreted with caution because of the research methods used. There is no rigorous evidence currently available, and so no recommendations can be made on the effectiveness of alarm systems in preventing patient falls.

Identification Bracelets

Mayo *et al*[75] evaluated the effectiveness of identification bracelets for patients at risk of falling in a rehabilitation hospital. This study, involving a total of 134 patients, found that bracelets were of no benefit in preventing falls among patients at high risk of falling. Identification bracelets, and coloured stickers on the patient's chart, bed or door, have also been evaluated as part of a program of fall prevention interventions[62,69,71,73,78,80-84]. Because the research methods used in these studies, the results must be interpreted with caution.

Because of the lack of rigorous evidence, no recommendations can be

made on the effectiveness of bracelets, or other methods of identifying high risk patients, in preventing patient falls.

Evaluation of Patient Fall Data

One study recommended evaluating incident form data to better understand falls [36]. This is a common theme of most of the descriptive studies analysed, in that many involved some form of evaluation of incident report data to determine the local risks for falling and the patient groups involved in falls. For many of this group of studies, this data provided the foundation for the development of a fall prevention programme.

Multiple Interventions

The most common approach utilised in studies was the use of a program of multiple fall prevention interventions aimed at individual patient's identified risk factors[62,69,71-73,77-91]. These programmes typically consisted of an assessment of a patient's risk of falling then implementation of interventions aimed at reducing these risks. The falls risk assessment tools used in these studies were all self developed. Some studies utilised different levels of interventions, in that as a patient's assessed risk of falling increased, so did the number of interventions employed[86,89,90]. One unpublished study used what was termed "Universal Fall Precautions", assuming that all patients are at some risk of falling[42], but how this is incorporated into clinical practice has not been adequately described.

In reviewing the identified studies, rigorous research methods were not used to evaluate the use of a programme of multiple interventions. A systematic review of falls in the elderly[2] found that significant protection against falling was achieved by interventions which targeted multiple identified risk factors in individual patients in non-hospital settings. While this was the most commonly employed approach to fall prevention used in the identified studies, its effectiveness has not been demonstrated in the acute care setting. The results of studies evaluating this approach are contradictory, some report a reduction in the number of falls[62,69,72,77-79,81,83,85,86,88-90], no change in the number[80,87,91], an increased rate of patient falls[82], or mixed results[84]. Of the studies reporting a reduction in the number of falls, the magnitude of the reduction was highly variable, including 4%[83], 21%[62], 44%[79], 60%[77,81], 81%[90], 100%[78]. The specific interventions were poorly defined in many studies. Information on how these multiple interventions were selected and implemented was limited and often not provided in the research reports.

Because of the lack of rigour in these studies, and the contradictory findings, the effectiveness of targeting multiple risk factors with a range of interventions can not be determined. While multiple interventions have been successful in reducing the number of falls in settings other than acute hospitals, their

effectiveness has not been demonstrated in hospitals. Currently no recommendations can be made regarding the effectiveness of a programme of multiple fall prevention interventions.

For the purposes of this review, the interventions that have been used in studies have been summarised under the following headings; assessment, education, risk of falling diagnosis, environmental issues, elimination, mobility, mental state, bedrest, medications, wheelchairs and miscellaneous issues. It should be noted that the effectiveness of these interventions have yet to be demonstrated, and this summary only represents the current clinical practice and research focus, and has been classified as level IV evidence (expert opinion).

Assessment

Some form of assessment of a patient's risk of falling was a common feature of most studies identified. In addition to this, assessment of risk was also used in specific situations and for select patients including:

- all confused and elderly before settling at night[36];
- post operative patients[64];
- on admission to the hospital or department[30,36];
- all elderly, on analgesics or sedatives[36].

Education

Educational activities were a common component of fall prevention programmes[12,27,30,36,64,73]. One small unpublished study used staff education sessions in conjunction with a documented plan for nursing care of patients at risk of falling, and while results were mixed across the participating areas, they failed to demonstrate a significant beneficial effect[92]. Examples of how education has been employed in fall prevention programmes include:

- staff training to increase awareness of high risk patients and of fall prevention interventions[12,27,36];
- educating patients and family about the risk of falling, safety issues and activity limitations[30,36,73];
- teaching patients to make position changes slowly[27,64];
- orientating patients to bed area, ward facilities and how to get assistance[36];
- developing patient education programme for all new and high risk patients[30].

Risk of Falling Diagnosis

Some studies report methods of communicating the risk of falling by incorporating a diagnosis or problem such as "At Risk of Falling" or "Potential for Injury" in the patient's records and charts[30,36]. Others have developed a specific plan for the nursing care of high risk patients to reduce the risk of falling[36,92]. One study implemented a clinical treatment and rehabilitation programme to reduce falls from internal causes[27], while

another interviewed all patients within 24 hours of a fall to assess the patient's risk and to plan their rehabilitation[30].

Environmental Issues

Activities that addressed environmental issues that have been used in studies include:

- decreasing environmental risks, obstacles and bedside clutter[12,27,64,73];
- nightlights at bedside and toilet[36,64,73];
- stabilising beds and bedside furniture[27,30];
- have grab bars near toilets, and that these should be fitted vertically rather than in a horizontal position[30].

Elimination

Special toileting needs was identified as a factor that increased a patient's risk of falling, and interventions to support a patient's elimination needs was common to many programmes of fall prevention interventions. These interventions include:

- placing patients with urgency near toilets[27];
- checking patients receiving laxatives and diuretics[64];
- toileting at risk patients routinely[12,69,72,73];
- instructing male patients prone to dizziness to void while sitting[27].

Mobility

Interventions related to mobility that have been used in studies include:

- non-skid footwear[27,64,73];
- providing physical therapy[12];
- instructing patients to rise slowly[27];
- walking high risk patients[12];
- repeating activity limits to patient and family[64];
- assisting high risk to patients transfer[12];
- walking patients in corridor once or twice per shift[69].

Mental State

Altered mental status was the most commonly identified risk factor for falling and interventions used in studies to address this problem include:

- re-orientating confused patients[73];
- orientating patients to the hospital environment[64];
- moving confused patients near nurses station[64,69];
- using family members to sit with confused patients[64,69];
- nursing confused patients in low bed[27].

Bedrest

Interventions that have been used in studies that are aimed at reducing the risk of falls while the patient is in, or near, their bed include:

- bed in low position[64];
- bed brakes on, and bedrails raised if applicable[64,73];
- ensuring patient can reach necessary items[73];
- using half length bedrails to reduce patient's need to climb over[30].

Medications

Activities related to medication from identified studies include:

- reviewing patient's medications frequently[30,64];
- checking for patients receiving laxatives and diuretics[64];
- limiting combinations of medications when possible (eg sedatives, analgesics, etc)[30].

Wheelchairs

Falls involving wheelchairs have been reported in descriptive studies, and interventions used to lower this risk include:

- using safety straps or seat belts in chairs and wheelchairs[27,73];
- using geriatric chairs[69];
- using latex mesh in chairs to prevent patients slipping[73];
- selecting suitable chairs that have arm rests and are of appropriate height for rising and sitting[27].

Miscellaneous

Many other interventions have been used to reduced the risk of falling including:

- coloured identification arm bands and stickers for doors and charts of patients at risk of falling[42,71,73];
- occupational therapy and diversional therapy[69,73];
- demonstrating the use of call bell to patients and ensure it is within reach of patient[64,73];
- involving family in care[64];
- reassessing staffing needs in relation to high risk patients[30].

Consciousness Raising

Some studies have reported an increased awareness of the risk factors associated with patient falls and of potential prevention strategies as a result of the implementation of a fall prevention programme[83,86,89]. It could be argued that it is this "consciousness raising" that is responsible for changes in fall rates, rather than the interventions. If consciousness raising is a factor in reducing patient falls, there is no evidence on the duration of this effect. It is also likely that interventions aimed at raising staff awareness of patient falls, will be different from interventions aimed at preventing them. This issue has not been addressed by any study, and therefore no recommendations can be made.

Restraints and Bedrails

The use of physical restraint is a controversial method to minimise the risk of falls through limiting mobility of patients. There is a range of physical restraint devices, including; jackets and vests, limb restraints, mitts, wristlets, anklets, and wheelchair restraints. The nature of bedrails is less clear, and have been viewed both as a restraint device and as a safety device.

While it has been shown that some falls will occur despite patients being under restraint[9,31,44,46,72], there has been no rigorous evaluation of their use. In one report the frequency of restraining patients was reduced over a six year period, from 52 per 1000 patient days, to 0.3, with minimal increase in the number of falls (7 falls per 1000 patient days increased to 8.7)[93]. This was achieved by implementing alternative fall prevention strategies, but as this was a clinical practice report, rather than experimental research, many factors could have influenced these findings. It was noted that a similar restraint reduction program in a geriatric long term care facility also reported no increase in the number of patient falls[94].

Bedrails are commonly used to minimise falls from hospital beds, but descriptive studies have shown that patients fall from bed despite bedrails being raised[19,25,31,43-46,51]. The only study identified that looked at the falls in relation to bedrails was a retrospective review of 181 incident forms[95]. This report challenges the effectiveness of bedrails, and highlights the need for high quality research into the effectiveness of bedrails for reducing the risk of falls, and the group of patients that would benefit from their use. While bedrails come in varying lengths and heights, there is no information on which is the most effective in stopping falls. For example, half length bedrails may stop accidental rolls from bed while not creating an obstacle for patients who would otherwise climb over the top of the rail.

From the studies reviewed, it is clear that bedrails and restraint devices do not provide complete protection from falls. There is some suggestion that physical restraint of patients can be replaced by other, more effective fall prevention strategies without an increase in patient falls, but this has not been supported by any quality research. Because of this lack of information no recommendations can be made regarding the use of restraints and bedrails. Further research is needed on the effectiveness and role, if any, of restraints and bedrails for fall prevention.

Increased Risk of Falling

While many factors have been cited as increasing a patient's risk of falling, the commonly identified factors include; age, mental status, history of falls, medications, special toileting needs and poor mobility. It was noted that the identified risk factors differed between studies. This may reflect the variable quality of this group of studies, or multifactorial nature of patient falls.

It is likely that patients with multiple risk factors, will be at greatest risk of falling. Some patient conditions (such as stroke), and some patient care areas (such as rehabilitation wards and geriatric departments), are associated with increased rate falls. The most common location of patient falls was at the bed side. The most common activity associated with patient falls was transferring to or from a bed or chair. No studies were identified that adequately addressed environmental causes of falls.

Assessment of Risk

Evidence on the effectiveness of falls risk assessment tools is limited, and their usefulness in clinical practice has yet to be demonstrated. On the available evidence, falls risk assessment tools are very inaccurate, in that they identify a large proportion of the patient population as being at risk of falling, which limits the tools clinical usefulness. There is no evidence to suggest that these generic risk assessment tools currently offer any advantage over tools developed for use within single institutions as part of a falls prevention programme, based on local patient characteristics.

Implications For Practice

This systematic review of research has highlighted the lack of quality research on patient falls in acute care hospitals.

This review has identified circumstances when patients may be at high risk of falling, and so would likely benefit from fall prevention interventions. Confused patients appear to be at greatest risk of falling. Patients who have previously fallen are not only at high risk of falling, but may possibly repeat the circumstances of the first fall in subsequent falls. Elderly patients may be at high risk of falling, but the full significance of age as a risk factor remains unclear. Other factors that may influence a patient's risk of falling include medications such as sedatives or analgesics, special elimination needs such as incontinence or frequency, or mobility deficits. Transferring from bed or chair is the most common activity at the time of falling. While it is likely that the fall prevention strategies that focus on these factors will be the most effective at reducing the number of patient falls, this has not been demonstrated by research.

Assessment of patients for risk of falling has been used in many studies and will likely help determine when and what special interventions should be implemented. Currently available assessment tools are very inaccurate and tend to identify a large proportion of the patient population as being at high risk of falling. There is little evidence to support the use of any one particular assessment tool, and indeed there is nothing to suggest the use of a generic assessment tool identified in the literature offers greater accuracy than tools developed by institutions based on local patient characteristics.

The evidence regarding the effectiveness of fall prevention interventions is contradictory. This review summarised the common approaches taken by researchers as an indication of expert opinion. This expert opinion suggests that institutions should have a formal falls prevention program, and that patient's with a high risk of falling should have this documented in their hospital records or case-notes and have this communicated to other health care workers. Some researchers utilised a diagnosis or problem such as "potential for injury", and developed special plans of care for high risk patients. The most common approach to fall prevention identified in the literature is through multiple interventions aimed at reducing the individual patient's risk of falling. These interventions focus on both environmental and patient causes of falls. While multiple interventions is the most common approach, the evidence on its effectiveness is contradictory.

While patient falls continues to be a problem in hospitals past research offers little help for clinicians in practice today.

Implications For Research

This review has also highlighted inadequacies in many published studies. Researchers often failed to provide a reasonable description of the research design, making assessment of their quality difficult. Many researchers failed to provide a complete description of the interventions used, making replication of the research impossible and incorporation of findings into clinical practice difficult. Many published studies failed to use rigorous research methods.

Despite the many published papers on falls in hospitals, there has been only a small amount of rigorous research published to date. A major finding of this systematic review is that there is an urgent need for quality research on patient falls, particularly in the area of fall prevention interventions.

References

1 Clarke R, Runciman W. Australian Incident Monitoring Study: Adelaide: Australian Patient Safety Foundation, 1998.

2 Gillespie LD, Gillespie WJ, Cumming R, Lamb SE, Rowe BH. Interventions to reduce the incidence of falling in the elderly, In: Gillespie WJ, Madhok R, Swiontkowski M, Robinson CM, Murray GD (eds.) Musculoskeletal Injuries Module of The Cochrane Database of Systematic Reviews. The Cochrane Library. Oxford: The Cochrane Collaboration, 1998.

3 Norton R, Butler M. Prevention of falls and fall-related injuries among institutionalised older people. New Zealand: National Health Committee, 1997.

4 National Health Committee. Prevention of falls in older populations: community perspectives. New Zealand, 1997.

5 Cynthia M, Oxman AE. (eds.) The Cochrane Collaboration Handbook [updated 1 March 1997], In: The Cochrane Library. Oxford: Update Software; 1996 ..Updated Quarterly: The Cochrane Collaboration, 1997.

6 NHS Centre for Reviews and Dissemination. Undertaking systematic reviews of research on effectiveness: CRD guidelines for those carrying out or commissioning reviews. York:University of York Publishing Services, 1996.

7 Dickersin K, Scherer R, Lefebvre C. Identifying relevant studies for systematic reviews. British Medical Journal 1994; 309: 1286-1291.

8 Quality of Care and Health Outcomes Committee. Guidelines for the development and implementation of clinical guidelines. Canberra: Australian Government Publishing Service, 1995.

9 Lau A. Possible factors of falls in elderly patients... presented at the First South-East Asian International Nursing Research Conference. Hong Kong Nursing Journal 1995; 69: 33-35.

10 Ashton J, Gilbert D, Hayward G, O'Dell C, Rogowski B. Predicting patient falls in an acute care nursing setting. Kansas Nurse 1989; 64: 3-5.

11 Plati C, Lanara V, Mantas J. Risk factors responsible for patients' falls. Scandinavian Journal of Caring Sciences 1992; 6: 113-118.

12 Hendrich A, Nyhuis A, Kippenbrock T, Soja ME. Hospital falls: development of predictive model for clinical practice. Applied Nursing Research 1995; 8: 129-139.

13 Byers V, Arrington ME, Finstuen K. Predictive risk factors associated with stroke patient falls in acute care settings. Journal of Neuroscience Nursing 1990; 22: 147-154.

14 Sutton J, Standen P, Wallace A. Accidents to patients in hospital: a comparative study. Nursing Times 1994; 90: 52-54.

15 Gales BJ, Menard SM. Relationship between the administration of selected medications and falls in hospitalized elderly patients. Annals of Pharmacotherapy 1995; 29: 354-358.

References

16 Tutuarima JA, de Haan RJ, Limburg M. Number of nursing staff and falls: a case-control study on falls by stroke patients in acute-care settings. Journal of Advanced Nursing 1993; 18: 1101-1105.

17 Gluck T, Wientjes HJFM, Rai GS. An evaluation of risk factors for in-patient falls in acute and rehabilitation elderly care wards. Gerontology 1996; 42: 104-107.

18 Morse JM, Tylko SJ, Dixon HA. The patient who falls... and falls again: defining the aged at risk. Journal of Gerontological Nursing 1985; 11: 15-18.

19 Morse JM, Tylko SJ, Dixon HA. Characteristics of the fall-prone patient. Gerontologist 1987; 27: 516-522.

20 Lund C, Sheafor ML. Is your patient about to fall? Journal of Gerontological Nursing 1985; 11: 37-41.

21 Mion LC, Gregor S, Buettner M, Chwirchak D, Lee O, Paras W. Falls in the rehabilitation setting: incidence and characteristics. Rehabilitation Nursing 1989; 14: 17-22.

22 Salgado R, Lord SR, Packer J, Ehrlich F. Factors associated with falling in elderly hospital patients. Gerontology 1994; 40: 325-331.

23 Janken JK, Reynolds BA, Swiech K. Patient falls in the acute care setting: identifying risk factors. Nursing Research 1986; 35: 215-219.

24 Donham JA, Sadewhite C, Seltzer MA, et al. Identifying characteristics of the fall-prone medical-surgical patient. Kansas Nurse 1987; 62: 5-6.

25 Morse JM, Prowse MD, Morrow N, Federspeil G. A retrospective analysis of patient falls. Canadian Journal of Public Health 1985; 76: 116-118.

26 Nyberg L, Gustafson Y. Patient falls in stroke rehabilitation. A challenge to rehabilitation strategies. Stroke 1995; 26: 838-842.

27 Sehested P, Severin Nielsen T. Falls by hospitalized elderly patients: causes, prevention. Geriatrics 1977; 32: 101-108.

28 Gaebler S. Predicting which patient will fall again ... and again. Journal of Advanced Nursing 1993; 18: 1895-1902.

29 Morris EV, Isaacs B. The prevention of falls in a geriatric hospital. Age and Ageing 1980; 9: 181-185.

30 Barbieri EB. Patient falls are not patient accidents. Journal of Gerontological Nursing 1983; 9: 164-173.

31 Lawrence JI, Maher PL. An interdisciplinary falls consult team: a collaborative approach to patient falls. Journal of Nursing Care Quality 1992; 6: 21-29.

32 Roberts BL. Is a stay in an intensive care unit a risk for falls? Applied Nursing Research 1993; 6: 135-136.

33 Sackley CM. Falls, sway, and symmetry of weight-bearing after stroke. International Disability Studies 1991; 13: 1-4.

References

34 Rapport LJ, Webster JS, Flemming KL, et al. Predictors of falls among right-hemisphere stroke patients in the rehabilitation setting. Archives of Physical Medicine and Rehabilitation 1993; 74: 621-626.

35 Mayo NE, Korner-Bitensky N, Kaizer F. Relationship between response time and falls among stroke patients undergoing physical rehabilitation. International Journal of Rehabilitation Research 1990; 13: 47-55.

36 Clark GA. A study of falls among elderly hospitalized patients. Australian Journal of Advanced Nursing 1985; 2: 34-44.

37 Mitchell P, Heckel L, Job M, et al. Falls Research Project (unpublished report): Ballina Hospital, Richmond Health Service, 1996.

38 Young C, Nash C, Ellson J. Benchmarking Patient Falls (unpublished report). Geelong: Barwon Health, 1997.

39 Brown B. Study of patient-falls in a small, busy medical centre. Critical Care Update 1983; 10: 30-36.

40 Mayo NE, Korner Bitensky N, Becker R, Georges PC. Preventing falls among patients in a rehabilitation hospital. Canadian Journal of Rehabilitation 1989; 2: 235-240.

41 Odetunde Z. Nursing the elderly: "Fell walking'. Nursing Mirror 1982; 154: 33-36.

42 Clark RA, Tyrrell D, Van Vagt D, Webb K, Hooper J What does green mean: a falls prevention programme for acute care (unpublished report). Adelaide: The Queen Elizabeth Hospital, 1998.

43 Walshe A, Rosen H. A study of patient falls from bed. Journal of Nursing Administration 1979; 9: 31-35.

44 Manjam NV, MacKinnon HH. Patient, bed and bathroom. A study of falls occurring in a general hospital. Nova Scotia Medical Bulletin 1973; 52: 23-25.

45 Aldridge E. Accidents will happen. Nursing Times 1991; 87: 45-46.

46 Innes EM, Turman WG. Evaluation of patient falls. Quality Review Bulletin 1983; 9: 30-35.

47 Snell WE. Accidents to patients in hospital. Lancet 1956; 1202-1203.

48 Sutton J, Standen P, Wallace A. Incidence and documentation of patient accidents in hospital... part 1 [corrected] [published erratum appears in Nursing Times 1994 Sep 7-13;90(36):54]. Nursing Times 1994; 90: 29-35.

49 Swartzbeck EM, Milligan WL. A comparative study of hospital incidents. Nursing Management 1982; 13: 39-43.

50 Stein J, Viramontes BE, Kerrigan DC. Fall-related injuries in anticoagulated stroke patients during inpatient rehabilitation. Archives of Physical Medicine and Rehabilitation 1995; 76: 840-843.

51 Catchen H. Repeaters: inpatient accidents among the hospitalized elderly. Gerontologist 1983; 23: 273-276.

References

52 Petrovsky CC. Accidents in the hospital. Medical Journal of Australia 1965; 2: 943-947.

53 Swartzbeck EM. The problems of falls in the elderly. Nursing Management 1983; 14: 34-38.

54 Scott CJ. Accidents in hospital with special reference to old people. Health Bulletin 1976; 34: 330-335.

55 Vlahov D, Myers AH, Al Ibrahim MS. Epidemiology of falls among patients in a rehabilitation hospital. Archives of Physical Medicine and Rehabilitation 1990; 71: 8-12.

56 Morgan VR, Mathison JH, Rice JC, Clemmer DI. Hospital falls: a persistent problem. American Journal of Public Health 1985; 75: 775-777.

57 DeVincenzo DK, Watkins S. Accidental falls in a rehabilitation setting. Rehabilitation Nursing 1987; 12: 248-252.

58 Morris EV, Isaacs B, Brislen W. Falls in the elderly in hospital. Nursing Times 1981; 77: 1522-1524.

59 Morse JM. Computerized evaluation of a scale to identify the fall-prone patient. Canadian Journal of Public Health 1986; 1: 21-25.

60 Brians LK, Alexander K, Grota P, Chen RWH, Dumas V. The development of the RISK tool for fall prevention. Rehabilitation Nursing 1991; 16: 67-69.

61 Moore T, Martin J, Stonehouse J. Predicting falls: risk assessment tool versus clinical judgement. Perspectives 1996; 20: 8-11.

62 Schmid NA. Reducing patient falls: a research-based comprehensive fall prevention program. Military Medicine 1990; 155: 202-207.

63 Morse JM, Black C, Oberle K, Donahue P. A prospective study to identify the fall-prone patient. Social Science and Medicine 1989; 28: 81-86.

64 Spellbring AM, Gannon ME, Kleckner T, Conway K. Improving safety for hospitalized elderly. Journal of Gerontological Nursing 1988; 14: 31-37.

65 Spellbring AM. Assessing elderly patients at high risk for falls: a reliability study. Journal of Nursing Care Quality 1992; 6: 30-35.

66 Nyberg L, Gustafson Y. Using the Downton Index to predict those prone to falls in stroke rehabilitation. Stroke 1996; 27: 1821-1824.

67 McCollam ME. Evaluation and implementation of a research-based falls assessment innovation. Nursing Clinics of North America 1995; 30: 507-514.

68 Larson E. Evaluating validity of screening tests. Nursing Research 1986; 35: 186-188.

69 MacAvoy S, Skinner T, Hines M. Clinical methods. Fall Risk Assessment Tool. Applied Nursing Research 1996; 9: 213-218.

70 Dawson-Saunders B, Trapp RG. Basic and Clinical Biostatistics. (2nd Edn.). East Norwalk:Appleton & Lange, 1994.

References

71 Fife DD, Solomon P, Stanton M. A risk/falls program: code orange for success... geriatric patients. Nursing Management 1984; 15: 50-53.

72 Bakarich A, McMillan V, Prosser R. The effect of nursing intervention on the incidence of older patient falls. Australian Journal of Advanced Nursing 1997; 15: 26-31.

73 Sweeting HL. Patient fall prevention — a structured approach. Journal of Nursing Management 1994; 2: 187-192.

74 Tideiksaar R, Feiner CF, Maby J. Falls prevention: the efficacy of a bed alarm system in an acute-care setting. Mount Sinai Journal of Medicine 1993; 60: 522-527.

75 Mayo NE, Gloutney L, Levy AR. A randomized trial of identification bracelets to prevent falls among patients in a rehabilitation hospital. Archives of Physical Medicine and Rehabilitation 1994; 75: 1302-1308.

76 Widder B. A new device to decrease falls... Ambularm. Geriatric Nursing 1985; 6: 287-288.

77 Morton D. Five years of fewer falls. American Journal of Nursing 1989; 89: 204-205.

78 Meissner BA. Patient fall prevention. Nursing Management 1988; 19: 78.

79 Innes EM. Maintaining fall prevention. Quality Review Bulletin 1985; 11: 217-221.

80 Kilpack V, Boehm J, Smith N, Mudge B. Using research-based interventions to decrease patient falls. Applied Nursing Research 1991; 4: 50-56.

81 Croft W, Foraker S. Working together to prevent falls. RN 1992; 55: 17-18.

82 Llwellyn J, Martin B, Shekleton M, Firlit S. Analysis of falls in the acute surgical and cardiovascular surgical patient. Applied Nursing Research 1988; 1: 116-121.

83 Rogers S. Reducing falls in a rehabilitation setting: a safer environment through team effort. Rehabilitation Nursing 1994; 19: 274-276, 322.

84 Craighead J, Fletcher R, Maxwell J. Seven steps for fall prevention. Dimensions in Health Service 1991; 68: 25-26.

85 Tuffnell C. Falling can seriously damage one's health—even in hospital. World Health Forum 1990; 11: 282-285.

86 Ruckstuhl MC, Marchionda EE, Salmons J, Larrabee JH. Patient falls: an outcome indicator. Journal of Nursing Care Quality 1991; 6: 25-29.

87 Mitchell A, Jones N. Striving to prevent falls in an acute care setting—action to enhance quality. Journal of Clinical Nursing 1996; 5: 213-220.

88 Cohen L, Guin P. Implementation of a patient fall prevention program. Journal of Neuroscience Nursing 1991; 23: 315-319.

References

89 Barker SM, O'Brien CN, Carey D, Weissman GK. Quality improvement in action: a falls prevention and management program. Mount Sinai Journal of Medicine 1993; 60: 387-390.

90 Hernandez M, Miller J. How to reduce falls. Geriatric Nursing 1986; 7: 97-102.

91 Rainville NG. Effect of an implemented fall prevention program on the frequency of patient falls. Quality Review Bulletin 1984; 10: 287-291.

92 Thomas L Patient Falls: Internal Medical Service (unpublished report). Adelaide: Royal Adelaide Hospital, 1996.

93 Powell C, Mitchell Pedersen L, Fingerote E, Edmund L. Freedom from restraint: consequences of reducing physical restraints in the management of the elderly. Canadian Medical Association Journal 1989; 141: 561-564.

94 Levine JM, Marchello V, Totolos E. Progress toward a restraint-free environment in a large academic nursing facility. Journal of the American Geriatrics Society 1995; 43: 914-918.

95 Halpert A, Connors JP. Prevention of patient falls through perceived control and other techniques. Law, Medicine and Health Care 1986; 14: 20-24.

96 Ballinger BR, Ramsay AC. Accidents and drug treatment in a psychiatric hospital. British Journal of Psychiatry 1975; 126: 462-463.

97 Cannard G. Falling trend... fall prevention. Nursing Times 1996; 92: 36-37.

98 Dugan J, Lauer E, Bouquot Z, Dutro BK, Smith M, Widmeyer G. Stressful nurses: the effect on patient outcomes. Journal of Nursing Care Quality 1996; 10: 46-58.

99 Gibbs J. Bed area falls: a recent report. Australian Nurses Journal 1982; 11: 34-37.

100 Grant JS, Hamilton S. Falls in a rehabilitation centre: a retrospective and comparative analysis. Rehabilitation Nursing 1987; 12: 74-76.

101 Heinemann D, Lengacher CA, VanCott ML, Mabe P, Swymer S. Partners in patient care: measuring the effects on patient satisfaction and other quality indicators. Nursing Economics 1996; 14: 276-285.

102 Hill BA, Johnson R, Garrett BJ. Reducing the incidence of falls in high risk patients. Journal of Nursing Administration 1988; 18: 24-28.

103 Johnson ET. Accidental falls among geriatric patients: can more be prevented? Journal of the National Medical Association 1985; 77: 633-639.

104 Jones WJ, Smith A. Preventing hospital incidents — what we can do. Nursing Management 1989; 20: 58-60.

105 Jones WJ, Simpson JA, Pieroni RE. Preventing falls in hospitals: the roles of patient age and diagnostic status in predicting falls. Hospital Topics 1991; 69: 30-33.

106 Kulikowski ES. A study of accidents in a hospital. Supervisor Nurse 1979; 10: 44-58.

References

107 Kustaborder MJ, Rigney M. Interventions for safety. Journal of Gerontological Nursing 1983; 9: 159-162, 173, 182.

108 Lynn FH. Incidents—need they be accidents? American Journal of Nursing 1980; 80: 1098-1101.

109 Moorat D. Accidents to patients. Nursing Times 1983; 79: 59-61.

110 Raz T, Baretich MF. Factors affecting the incidence of patient falls in hospitals. Medical Care 1987; 25: 185-195.

111 Rohde JM, Myers AH, Vlahov D. Variation in risk for falls by clinical department: implications for prevention. Infection Control and Hospital Epidemiology 1990; 11: 521-524.

112 Webster JS, Roades LA, Morrill B, et al. Rightward orienting bias, wheelchair maneuvering, and fall risk. Archives of Physical Medicine and Rehabilitation 1995; 76: 924-928.

Appendix 1

Checklist for Assessing Validity of Experimental Studies

Ref No. .....

Experimental Studies	**Yes**	**No**	(if no use other checklist)
Was the assignment to treatment groups really random	**Yes**	**No**	**?**
Were participants blinded to treatment allocation	**Yes**	**No**	**?**
Was allocation to treatment groups concealed from allocator	**Yes**	**No**	**?**
Were the outcomes of people who withdrew described and included in the analysis (ie was the analysis by intention to treat)	**Yes**	**No**	**?**
Were those assessing outcomes blind to the treatment allocation	**Yes**	**No**	**?**
Were the control and treatment groups comparable at entry	**Yes**	**No**	**?**
Were groups treated identically other than for the named interventions	**Yes**	**No**	**?**
Were outcomes measured in the same way for all groups.	**Yes**	**No**	**?**
Were outcomes measured in reliable way.	**Yes**	**No**	**?**
Was an appropriate statistical analysis used	**Yes**	**No**	**?**

SUMMARY

TOTAL

Yes _____ **No** _____ **?** _____

DECISION

USE	REJECT
NARRATIVE SUMMARY ONLY	FURTHER INFORMATION NEEDED

COMMENTS

Appendix 2

Included Studies

Citation	Summary	Method	Level Evidence
Ref. 274, Aldridge, E., 1991,[45]	Setting acute care hospital 12 month survey from incident forms Population 782 accidents Comment Deals with all accidents not just falls. Minimal information given on method and on results.	descriptive	IV
Ref 282, Ashton, J., Gilbert, D., Hayward, G. *et al.*, 1989,[10]	Setting metropolitan hospital Looked at predetermined variables. Population fallers - 43 non-fallers 1657 Comment case and control numbers different	case control	III.2
Ref 1454, Bakarich, A., McMillan, V. and Prosser, R., 1997,[72],.	Setting acute care hospital Population 2,023 pts assessed Results 24% assessed as at risk 76% not at risk significantly fewer falls in toileted at risk group than non toileted at risk group. Comment Assessment of risk & then toileting of at risk patients Assessment assessed each shift 36% of pts. not assessed	clinical trial no control no randomisation	IV
Ref. 1346, Ballinger, B. R. and Ramsay, A. C., 1975,[96]	Setting 625 bed hospital 2 year period Population 351 accidents of which 67% were falls Comment deals with all accidents	descriptive	IV
Ref 297, Barbieri, E. B., 1983,[30]	Setting veterans medical centre Population 420 incidents	descriptive	IV

Appendix 2

Citation	Summary	Method	Level Evidence
298 Barker, S et al 1993,[89]	Setting two psychiatric units Population all patients Results 6.84falls/1000 patient days pre intervention 4.16 falls/1000 patient days post intervention Comment 1 year falls awareness program falls assessment then 3 levels of interventions	self controlled study	III-3
Ref 333, Brians, L. K., Alexander, K., Grota, P., *et al,* 1991,[60],	Setting acute and extended care medical centre Population 899 in testing tool 208 non-fallers 78 fallers Comment development of tool from literature & falls data, and tested on 10 units	cohort study	111.2
Ref 336, Brown, B., 1983[39]	Setting Veterans Medical Centre Population total of 109 falls Comment no information given about method	descriptive	IV
Ref. 344, Byers, V., *et al.*, 1990,[13]	Setting acute care setting (two hospitals) Population 202 stroke patient fallers 111 stroke patient non-fallers Results predictive factors: history of falls, impaired decision making, restlessness, weakness, abnormal haemocrit, and easily fatigued. Comment identified predictive factors for falls in stroke patients.	case control	III.2
Ref. 1350, Catchen, H., 1983,[51]	Setting repeat fallers at municipal hospital Population 954 accidents Comment accidents not just falls	descriptive	IV
Ref 368, Clark, G. A., 1985,[36]	Setting teaching hospital Population 169 falls	descriptive	IV

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 1501 Clark, *et al.* 1998,[42]	Setting acute care hospital Population patients in 3 medical wards Results minimal data provided Comments utilised a range of interventions, including armbands , to promote falls awareness	descriptive	IV
Ref. 372, Cohen, L. and Guin, P. 1991,[88]	Setting Hospital Population neuro patient Results initial fall rate 3.8 after one year fall rate below 3.8 for 4 straight months Comment all patients assessed for fall risk different care plans instituted for aware and unaware high risk patients	self controlled study	III-3
Ref. 351, Connard, G., 1996,[97]	Setting nursing development unit Population 6000 patient days 61 falls Comments minimal information given	descriptive	IV
Ref. 383, Craighead, J. et al 1991,[84]	Setting community hospital Population not stated Results 3.6/1000 pre-interventions increase to 10 then fall to 7/1000 patient days post intervention Comment minimal information given. interventions green armband, staff participation, patient and family involvement	self controlled study	III-3
Ref. 386, Croft, W. and Foraker, S. 1992,[81]	Setting 220 bed hospital Population all patients Results 60% reduction in falls Comment 6 year study, green dot to flag patients at high risk family involved in patient safety programme	self controlled study	III-3

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 1471, DeVincenzo, D.K. and Watkins, S., 1987,[57]	Setting rehabilitation centre Population 209 falls 162 fallers 162 non-fallers Results Environmental variables associated with falls: - week of hospitalisation, day of week, activity level, and site and equipment wheelchairs involved in 57% of falls 83% of fallers CVA patients	case control	III.2
Ref 407, Donham, J. A., Sadewhite, C. Seltzer, M. A., *et al.*, 1987,[24]	Setting community hospital Population total of 155 falls	descriptive	IV
Ref 412, Dugan, J., Lauer, E., and Bouquot, Z., *et al.* 1996,[98]	Setting acute care hospital Population 293 returned survey forms Comment looked at the relationship between nursing stress levels and patient outcomes (all types of incidents)	descriptive	IV
Ref 442, Fife, D. D., Solomon, P. and Stanton, M., 1984,[71]	Setting hospital Population 538 assessed tested on four units (2 control and 2 treatment). High risk pts. Intervention orange alert identification and 18 nursing interventions Instrument a self developed risk assessment card Results 82% identified at high risk no statistical difference in fall numbers between control and treatment units.	non-randomised controlled trial	111.1
Ref. 450, Gaebler, S., 1993,[28]	Setting acute care hospital Population 50 multiple fallers 50 single fallers matched by age and sex Comment reviewed characteristics of multiple fallers	case control	III.2

Appendix 2

Citation	Summary	Method	Level Evidence
Ref 95, Gales, B. J. and Menard, S. M., 1995,[15]	Setting private hospital Population 70 years and older 100 fallers 100 controls matched for age and gender	case control	III.2
Ref. 467, Gibbs, J., 1982,[99]	Setting reviewed falls in the immediate bedside area. data collected from incident forms, and interviews with patients and staff Population 32 falls Results listed reasons for patient getting out of bed.	descriptive	IV
Ref 96, Gluck, T., Wientjes, H. J. F. M. and Rai, G. S., 1996,[17]	Setting acute and rehab wards Population 50 fallers 50 non-fallers matched with other pt. on same ward for age & sex.	case control	III.2
Ref. 487, Grant, J. S. and Hamilton, S., 1987,[100]	Setting 78 bed rehabilitation centre data collected during 2 six month periods Population Period I - 56 falls Period II 43 falls Results patients at risk of falling - 60 years and older, CVA or closed head injuries, history of falls	descriptive	IV
Ref. 499, Halpert, A. *et al.* 1986,[95]	Setting 200 bed community hospital Population 181 falls Results details of falls given Comment minimal information provided	descriptive	IV

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 513, Heinemann, D. et al. 1996,[101]	Setting 518 bed community hospital Population pilot = 314 patients control = 135 patients Results fall rates between pilot and control not significant Comment randomly selected pilot and control nursing units but not patients pilot- partners in patient care model control- total patient care model	non randomised control trial,	III-1
Ref 519, Hendrich, A., Nyhuis, A., Kippenbrock, T. and Soja, M. E. , 1995,[12]	Setting acute care hospital Population 102 fallers 236 non- fallers Results - sensitivity 77% (79 of 102) - specificity 72% (169 of 236) Comment identified falls risk factors present their prevention strategy.	case control	111.2
Ref. 1355, Hernandez, M and Miller, J. 1986,[90]	Setting 21 bed psychogeriatric unit Population not stated Results fall rate decreased total of 81.7% over 2 years Comment minimal information provided 3 levels of fall prevention dependent upon patient characteristics	self controlled study	III-3
Ref. 526, Hill, B.A.,, *et al.*, 1988,[102]	Setting venterans medical centre Population 180 fallers Results description of falls given	descriptive	IV
Ref. 1478, Innes, E. 1985,[79]	Setting acute care hospital Population not stated Results 44% decrease in falls Comment minimal information provided identify high risk patients interventions tailored to each patient	self controlled study	III-3

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 537, Innes, E. M. Turman, W. G., 1983, [46]	Setting 362 bed acute care hospital Population 270 falls Comment phase I incident forms analysed phase II. pilot study - fall prevention interventions	I. Descriptive II. Pilot study	IV
Ref. 548, Janken, J.K., *et al.* 1986,[23]	Setting 719 teriary care medical centre Population 331 fallers 300 non-fallers Results identified significant factors related to falls	case control	III.2
Ref. 1356, Johnson, E.T. 1985,[103]	Setting 955 bed medical centre Population 195 patients 241 falls Results nursing home patients sustained more injuries Comments included nursing home patients of hospital. comparison of acute care and nursing home patients.	descriptive	IV
Ref. 552, Jones, W.J. and Smith, A., 1989, [104]	Setting large metropolitan hospital Population data from approximately 1000 incident reports. 234 falls Results details of falls given	descriptive	IV
Ref. 553, Jones, W.J., *et al.*, 1991,[105]	Setting urban medical centre Population 234 fallers 185 non-fallers Results age and diagnostic status significant factors Comment control group not matched to fallers	case control	III.2

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 574, Kilpack, V. et al. 1991,[80]	Setting two medical surgical specialty units Population not stated Results pre-intervention- 116 falls post-intervention- 111 falls (ns)	self controlled study	III-3
Ref. 1357, Kulikowski, E.S. 1979,[106]	Setting veterans hospital Population 94 accident reports (involving 86 patients) Comment deals with all types of accidents	descriptive	IV
Ref. 1358, Kustaborder, M. J. 1983, [107]	Setting `850 bed hospital Population not stated Results 9% increase in total accidents 63% of these were falls	self controlled study	III-3
Ref 597, Lau, A., 1995,[9]	Setting 4 geriatric wards of acute hospital Population case (fallers) - 37 control (non-fallers) - 37 Selection of control by admission time, but with no history of falls.	case control	III.2
Ref 599, Lawrence, J. I. and Maher, P. L., 1992,[31]	Setting medical unit in acute care hospital Population pts. over 65 who fell total of 19 patients fell (21 falls) Comment simple post fall assessment	descriptive	IV
Ref. 613, Llewellyn, J. et al. 1988, [82]	Setting 309 bed cardiovascular surgical unit Population all patients admitted to unit Results fall rate 3.4/month pre-intervention fall rate 4.4 then 3.8/month in first and second year. Comment 2 year 10 month study all patients assessed for fall risk interventions instituted	self controlled study	III-3

Appendix 2

Citation	Summary	Method	Level Evidence
Ref, 1360, Lund, C. and Sheafor, M. L., 1985, [20]	Setting community hospital Population fallers - 76 non fallers 76 selection of controls - randomly selected patients with no history of falls.	case control	III.2
Ref. 1361, Lynn, F.H 1980,[108]	Setting 629 bed hospital Population 200 nurse initiated incident reports Comments minimal information given	descriptive	IV
Ref 618, MacAvoy, S., Skinner, T. and Hines, M., 1996,[69]	Setting community hospital Population 40 case 40 control Results - Reliability .9 - Sensitivity 43% - Specificity 70% Comments Study to determine the reliability and validity of falls risk assessment tool 17 minutes to do assessment score > 10 = interventions instituted	case control	111.2
Ref. 1482, Manjam, N. V. and MacKinnon, H. H.1973, [44]	Setting 318 bed general hospital Population 130 fallers total of 143 falls	descriptive	IV
Ref 141, Mayo, N. E. Gloutney, L. Levy, A. R., 1994,[75]	Setting rehabilitation hospital Population 65 treatment 69 control Results 27 of 65 fell 21 of 69 fell hazard ratio = 1.3 (95% CI. 0.8 - 2.4) results failed to identify any benefit in using bracelets. Comments evaluated effectiveness of identification bracelets for patients at risk of falling.	RCT	II

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 634, Mayo, N. E., Korner Bitensky, N., Becker, R., *et al.*, 1989,[40]	Setting 120 bed public rehabilitation hospital 2 year period Population 356 fallers 648 falls Results fall rate 19.7% of admissions 80% of falls in ward 66% during toileting or transferring	descriptive	IV
Ref 140, Mayo, N. E., Korner-Bitensky, N. and Kaizer, F., 1990,[35]	Setting Stroke Unit in Rehab Hospital Population 95 fallers 107 non-fallers Comment aim was to determine if slow motor response time was associated with increased of falling	cohort	III.2
Ref 639, McCollam, M. E., 1995,[67]	Setting cardiology general medical unit Population 458 pts. (assessed 1 -45 times) Results identified 54% of fallers interrater reliability 98% sensitivity 91% specificity 54% Pos. Predictive value 10% Neg. Predictive Value 99% Comment Pilot study using Morse Fall Scale 24% increase in falls from year before to year after implementation hospital wide	clinical trial no randomisation no control	IV
Ref. 645, Meissner, B. A. 1988,[78]	Setting 35 bed medical unit Population not stated Results 10 falls in 6 months pre-intervention 6 months post-intervention- 100% decrease in falls Comment assessment of patient mentation and safety interventions instituted	self controlled study	III-3
Ref 1479, Mion, L. C., Gregor, S. Buettner, M., Chwirchak, D. *et al.*, 1989,[21]	Setting 2 general medical rehab units (28 beds) Population total 143 pts 46 fallers	Cohort	III.2

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 664, Mitchell, A.and Jones, N. 1996,[87]	Setting acute care hospital Population not stated Results pre-intervention- 7.77/1000 bed days post-intervention[a]- 4.42/1000 bed days (ns, p>0.05)	self controlled study	III-3
Ref. 1495, Mitchell, P., *et al.* 1996,[37]	Setting 29 bed medical unit Population all patients in unit Results provide descriptive data	descriptive	IV
Ref. 1363, Moorat, D. 1983,[109]	Setting general acute hospital Population patients of hospital Results using toilet or commede most common activity at time of fall. Comment minimal information given. data from accident report forms	descriptive	IV
Ref 668, Moore, T., Martin, J. and Stonehouse, J., 1996,[61],	Setting community hospital Population 39 patients 187 paired assessments Results interrater reliability - 76% (AT) sensitivity - ranged 50% to 60% (AT) - range 31% to 50% (CJ) specificity - range 52% to 60% (AT) - range 60% to 81% (CJ) Positive Predictive Value (PPV) - range 16% to 43% (AT) - 33% (CJ) Negative Predictive Value (NPV) - range 75% to 85% (AT) - range 67% to 90%(CJ) Comment compared assessment tool (AT) to clinical judgement (CJ) in identifying high risk pts.	instrument development	IV
Ref. 671, Morgan, V. R., Mathison, J. H., Rice, J. C., *et al.*, 1985,[56]	Setting 152 bed acute care specialty hospital Population 229 fallers total of 250 falls	descriptive	IV

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 1367, Morton, D. (1989)[77]	Setting medical unit of hospital Population not stated Results decrease in falls by 25% then 8% in the first 2 years with addition of bed alarm system decrease in falls by 60% after 5 years	self controlled study	III-3
Ref 1364, Morris, E. V. and Isaacs, B., 1980,[29]	Setting geriatric dept. of hospital Population total of 325 patients 236 of these fell	descriptive	IV
Ref. 673, Morris, E. V., Isaacs, B. and Brislen, W., 1981,[58]	Setting geriatric department of general hospital Population 236 falls	descriptive	IV
Ref 677, Morse, J. M., 1986,[59],	Setting data from previous study Population 100 fallers 100 non fallers Comment development / identification of risk factors for scale	case control	111.2
Ref 678, Morse, J. M., Black, C. Oberle, K., *et al* , 1989,[63],	Setting at 2 institutions involving 16 units. long term care & rehab setting. Population 2,689 patient Result able to identify day to day variations in risk define fall types as - anticipated physiological, unanticipated physiological & accidental Comment takes less than 3 minutes to do.	descriptive	IV
Ref 676, Morse, J. M., Prowse, M. D., Morrow, N., *et al.*, 1985,[25]	Setting metropolitan teaching hospital Population 429 fallers (for total of 774 falls) 122 randomly selected for detailed analysis	descriptive	IV

Appendix 2

Citation	Summary	Method	Level Evidence
Ref 1365, Morse, J. M., Tylko, S. J. and Dixon, H. A., 1987,[19]	Setting acute hospital (with geriatric unit) Population 100 fallers 100 non fallers (randomly selected) Selection of control by bed numbers.	case control	III.2
Ref. 675, Morse, J. M., Tylko, S. J. and Dixon, H. A., 1985,[18]	Setting large urban hospital (with long term geriatric centre. Population 20 non-fallers matched by diagnosis, age and sex. Comment reviewed the characteristics of the multiple faller	case control	III.2
Ref 698, Nyberg, L. and Gustafson, Y., 1996,[66]	Setting stoke rehab unit over 1 year period Population 135 patients Results sensitivity 91% specificity 27% overall accuracy of prediction 52% identified 80% of pts. as at risk of falling Comments Assessed Downton Fall Risk Index in to determine its accuracy of prediction	instrument development	IV
Ref 1368, Nyberg, L. and Gustafson, Y., 1995,[26]	Setting stroke rehab unit Population total of 161 patients (62 of these fell) total of 153 falls	descriptive	IV
Ref 1369, Odetunde, Z., 1982,[41]	Setting 5 short stay wards 6 month period Population 113 paients fell 270 falls Results Highest falls: age - 70 -89, diagnosis - CVA, previous falls, parkinsons, drugs - laxatives, analgesics, sedatives, cardiac druds location - bedside most common, dayroom	descriptive	IV

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 1370, Petrovsky, C. C., 1965,[52]	Setting general hospital Population 959 accidents, of which 809 were falls	descriptive	IV
Ref 727, Plati, C., Lanara, V. and Mantas, J., 1992,[11]	Setting general hospital Population 108 fallers 106 controls matched for age, sex, disease, medication taken, hospital ward Comment involved only falls occurring at night	case control	III.2
Ref. 741, Rainville, N. 1984,[91]	Setting short term care facility Population all patients on 30 bed medical unit Results no significant reduction in # of falls over entire unit (26 versus 27) Comment Assessment tool designed 3 month study on high incidence unit instituted interventions	self controlled study	III-3
Ref 745, Rapport, L. J., Webster, J. S. Flemming, K. L., Lindberg, J. W. Godlewski, M. C., *et a.*, 1993,[34]	Setting inpatient rehabilitation medicine service Population 32 patients 15 patients fell Comment involved non-ambulant males with right hemisphere strike	cohort	III.2
Ref 1371, Raz, T. and Baretich, M. F., 1987,[110]	Setting 4 hospitals (community x2, veterans, university) Population falls data from 4 hospitals	descriptive	IV
Ref. 758, Roberts, B. L., 1993,[32]	Setting general medical and surgical units of medical centre Population 120 ICU patient falls 106 non-ICU patient falls Comment looked at whether admission to intensive care was a factor in patient falls.	cohort	III.2

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 763, Rogers, S. 1994[83]	Setting 160 bed rehabilitation hospital Population all patients Results program has reduced repeat falls from 15% to 11% Comment 2 year study patients assessed upon admission, patients flagged with fluorescent orange stickers on bed, care plan and chart.	self controlled study	III-3
Ref. 764, Rohde, J. M., Myers, A. H. and Vlahov, D., 1990[111]	Setting 1000 bed acute care hospital Population 874 falls	descriptive	IV
Ref. 769, Ruckstuhl, M. C. et al. 1991,[86]	Setting acute care medical centre Population not stated Results 2 year audit 33% decrease in fractures due to falls in 1st year, 83% decrease at end of 2nd Falls kept below threshold of 4.1/1000 patient days Comment risk assessment of patient three level fall prevention protocol instituted with level dependent upon level of risk	self controlled study	III-3
Ref 171, Sackley, C. M., 1991,[33]	Setting general hospital Population total of 92 patients 47 fell Comment involved only stroke patients	cohort	III.2
Ref 173, Salgado, R., Lord, S. R., Packer, J., *et al.*, 1994,[22]	Setting acute hospital Population 44 fallers 44 non fallers matched for controls by age, sex type (eg medical, surg), primary diagnosis.	case control	III.2

Appendix 2

Citation	Summary	Method	Level Evidence
Ref 780, Schmid, N. A., 1990,[62],	Setting 700 bed medical centre Population Phase 1 102 fallers & 102 control Phase 2 338 patients Results sensitivity 95% (adjusted to 93%) specificity 66% (adjusted to 78%) interrater reliability 83% to 99% 54% decline in fall numbers (38 to 42 falls per 10,000) Phase 3 - 54% decline in fall numbers (38 to 42 falls per 10,000) Comment Phase 1 - development of a fall risk assessment Phase 2 - testing reliability and validity. Phase 3 - patient assessed upon admission, interventions instituted	Phase 1 case control Phase 2 testing validity and reliability Phase 3 before and after study	IV
Ref, 1472, Scott, C. J., 1976,[54]	Setting group of hospitals Population 279 accidents 259 of these falls Comment deals with all accidents	descriptive	IV
Ref 1374, Sehested, P. and Severin Nielsen, T., 1977,[27]	Setting hospital geriatric dept. Population 511 patients of which 134 fell (total of 264 falls)	descriptive	IV
Ref. 1483, Snell, W. E., 1956,[47]	Setting general hospital Population 653 accidents Comments deals with all accidents	descriptive	IV
Ref 819, Spellbring, A. M., 1992,[65].	Setting acute care setting Population 30 patients Results inter-rater reliability over all 90% Comments Testing reliability of previously reported risk assessment tool. Minimal information given 17 minutes to complete	instrument development	IV

Appendix 2

Citation	Summary	Method	Level Evidence
Ref 1375, Spellbring, A. M., Gannon, M. E., Kleckner, T. and Conway, K., 1988,[64]	Setting nursing units Population 2 units Comments Minimal information given. Development and testing of an instrument to assess risk of falling.	instrument development	IV
Ref. 825, Stein, J., *et al.*, 1995,[50]	Setting rehabilitation hospital Population 400 falls in post stroke patients - 93 patients receiving anticoagulants - 175 patients not receiving anti-coagulated. Results no increased risk of injury in anticoagulated patients Comment fall related injuries in anticooagulated stroke patients	cohort	III.2
Ref 1377, Sutton, J., Standen, P. and Wallace, A., 1994,[14]	Setting acute hospital Population 50 case (fallers) 50 control (non-fallers) control matched for age, sex, ward type and length of stay, but no falls history	case control	III.2
Ref. 1378, Sutton, J., Standen, P. and Wallace, A., 1994,[48]	Setting 10 wards in hospital Population 728 accidents 498 were falls Comment deals with all accidents	descriptive	IV
Ref. 839, Swartzbeck, E. M., 1983,[53]	Setting Veterans hospital 3 study periods (3 months, 12 months & 12 months) Population 842 Results provide a description of falls and fallers	descriptive	IV

Appendix 2

Citation	Summary	Method	Level Evidence
Ref. 1379, Swartzbeck, E. M. and Milligan, W. L., 1982,[49]	Setting veteran's hospital Population I. - 94 incidents, II. - 492 incidents Comment 2 case series studies (3 mth & 1 yr) deals with all incidents	descriptive	IV
Ref 841, Sweeting, H. L., 1994.[73],	Setting acute care and rehabilitation Population not stated Results before implementation- 77 falls after implementation- 44 falls (41% decrease) Comment Developed own risk assessment tool assessment part of program (eg green arm bands)	self controlled study	III.3
Ref 686, Tideiksaar, R. Feiner, C. F. Maby, J., 1993,[74]	Setting acute care setting Population 35 treatment 35 control Results intervention 1 of 35 falls from bed control 4 of 35 falls from bed no statistical difference (p = 1.00) Comment evaluated effectiveness of bed alarms very small study	RCT	II
Ref. 1497, Thomas, L., 1996,[92]	Setting 3 medical wards of acute hospital Population 3 intervention wards - 19 falls 1 control ward - 14 falls Results no significant benefit	non-randomised controlled trial	III.1
Ref 881. Tuffnell, C. 1990[85]	Setting general hospital Population all patients in adult inpatient areas of a 280 bed hospital Results Results: 245 falls before, 148 falls after 7.15 falls/1000 patient days before 4.46 falls/1000 patient days after Comments a risk assessment followed by a falls alert system instituted for patients deemed high risk	self-controlled study	III.3

Appendix 2

Citation	Summary	Method	Level Evidence
Ref 883, Tutuarima, J. A., de Haan, R. J. and Limburg, M., 1993,[16]	Setting stroke patients in acute care setting Population 49 fallers 49 control matched for age, ward, sex, number of hospital days at time of fall, stroke severity	case control	III.2
Ref. 903, Vlahov, D., Myers, A. H. and Al-Ibrahim, M. S., 1990,[55]	Setting 151 bed Rehabilitation hospital I year period Population 71 falls in 567 patients.	descriptive	IV
Ref. 1384, Walshe, A. and Rosen, H., 1979, [43]	Setting 300 bed community hospital Population 53 falls	descriptive	IV
Ref. 204, Webster, J.S. *et al.*, 1995,[112]	Setting rehabilitation unit of veterans hospital Population patients with right cerebrovascular accident Results patients with rightward orienting bias had more falls.	descriptive	IV
Ref. 934, Widder, B. 1985,[76]	Population 16 patients (8 on each of two wards) Results no falls during this period Comment patients determined to be high risk given ambularm, bed alarm system one month trial	non-randomised control trial	III-1
Ref. 1496, Young, C., *et al.*, 1997,[38]	Setting 5 acute care hospitals Population hospital patients Results descriptive data on falls	descriptive	IV