Risk Assessment Tool for the Prediction of fall

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Abstract: *An effective tool for the prediction of fall risk among the patients admitted in wards requires high sensitivity with specificity, good predictive value and easy to use in the clinical practice. Objective of the study is to develop fall risk assessment tool. Study was done on patients admitted at MMIMS&R Hospital, Mullana, Ambala and Methodological approach was used. From related review of literature, experts' guidance and investigators' personal experience, a list of risk factors were identified and compared with standardized risk assessment scales i.e. Morse Fall Scale & Fall Risk Assessment & Screening Tool i.e FRAST. Content validity was ascertained by expert's opinion & was found to be 0.94. The range of rating score was 12 to 48, with the assumption that higher the scores, the greater the risk of falls. At a cut-off point of ≥ 18, the best balance between the sensitivity and specificity was achieved, i.e. sensitivity was 26.42%, specificity 85.71%, predictive value positive 26 % and predictive value negative 74%. Cronbach's alpha and item item Correlation were used to measure the internal consistency of the tool, Coefficient alpha was 0.75, statistically significant at 0.001 levels. Item-item correlations were moderate (between 0.30 to 0.70) among most of the items. In order to estimate equivalence Inter-rater reliability method was used & percentage of agreement between raters was 84%. Concurrent validity of fall risk assessment tool was checked by calculating Pearson correlation in between the fall risk assessment tool and Morse Fall Scale & was found to be 0.70.*

I. Introduction:

Falling is one of the adverse events that occur most often in acute care hospitals and continues to be a complex challenge that acute care hospitals face. Incidence of falling is also a sensitive nursing quality indicator together with pressure ulcer incidence and pain management (American Nurses Association, 2008).

Falls present an overwhelming clinical and public health problem in both community and hospitalized patients. For the inpatient, consequences may include not only serious physical injuries[1-4] but also psychological effects, such as anxiety, depression[5] and loss of confidence[6]. They lead to greater disability, longer duration of stay in the hospital and increased costs.

Falls account for at least 40% of all accidents in hospital[7].Risk of hip fracture was found to be 11 times greater in hospital patients compared to those in the community.

In the United States, the incidence rate of falls in acute care hospitals was 2–10% of all hospitalized patients, which accounts for 38% of total adverse events.

The rate of inpatient falls has been reported between 2.9 and 13 falls per 1,000 bed days[8]; and those falls involve between 13% and 32% of admitted patients [9]. The National Health Service of the United Kingdom reports an average fall rate of 4.8 falls/1,000 patient days nationwide.

Risk assessment is recommended as the first step in the prevention of falls in hospitals. Assessment has to be performed on admission, and must be reassessed whenever there is a significant change in the patient's condition. A fall risk assessment tool will help the nurses to make a systematic assessment of the patient's condition and risk of fall. This can become an important foundation for prevention and quality assurance. The main benefit of using a fall risk assessment tool may lie in its acting as a reminder to nurses for the possibility of falls. A simple reminder would be easier to use and less time consuming.

Some previous research has identified risk factors for falling in the hospital, nursing home and communities were impaired balance or gait, altered mobility, history of falling, increasing age, impaired cognition, depression, dizziness or vertigo, orthostatic hypotension, visual impairment, and use of certain medications such as benzodiazepines, antipsychotics, and sedatives. Studies also document altered elimination patterns and specific diagnoses as fall risk factors in the hospital.

Sensitivity and specificity were the most commonly used and recommended statistics for evaluating the predictive validity of fall risk assessment tool, assuming that a good and useful tool should have both high sensitivity and high specificity. The validity of a risk assessment tool is the degree to which the risk is correctly predicted. Most of the tools reported in the literature have not been subjected to test the sensitivity, specificity or predictive value.

Researcher's experience that most of the patients were vulnerable to fall during hospitalization at MMIMS&R Hospital, Mullana, Ambala and It was observed that when a fall occurs, hospital costs and duration of hospitalization increases multifold. There was absence of standard tool to identify risk factor for patients at risk for falls. Hence the researcher got insight to develop fall risk assessment tool for the prediction of falls.

Objectives:
- To develop fall risk assessment tool.

Delimitations:
- The study was delimited to Medical surgical units of MMIMS&R Hospital Mullana, Ambala.

II. Methodology:

A methodological approach was used for the development of Fall Risk Assessment Tool for the prediction of falls in patients. The study was conducted in selected areas of MMIMS&R Hospital, Mullana, Ambala.

PHASE I- PREPARATION OF PRELIMINARY DRAFT OF FALL RISK ASSESSMENT TOOL
This phase was completed in three steps.

a) Review of literature

The review of literature for the present study was done for various risk factors that were causing falls in hospitalized patients. Books, journals, periodicals and fall risk assessment tools (e.g. Morse Fall Scale, Fall Risk Assessment & Screening Tool i.e FRAST) used in various hospitals were reviewed for the current topic.

b) Generation of item pool

An exhaustive list of the risk factors causing falls in hospitalized patients was prepared from literature review, discussion with staff nurses and nursing faculty, expert guidance as well as from the researcher's personal experience of assessing the patients. Related items such as age, recent history of fall, mental state, medications, sensory/ perception, patient care equipments etc. were selected from the content and the items were pooled together.

c) Preparation of preliminary draft

The blue print of fall risk assessment tool for the patients had been prepared. Suggestions from the guide and co-guide and personal experience of the investigator played an important role in the preparation of tool.

First draft of fall risk assessment tool for the patients was prepared. In this draft the items included in tool were age, falls history, mental state, sensory perception, medications and patient care equipments. Each category has been given an equal weightage and Scoring of the fall risk assessment tool was done as 0, 1, 2, and 3. Maximum score was 24 and minimum was 0. Criteria measure for the risk level was made.

PHASE II- VALIDATION OF FIRST DRAFT AND SUBSEQUENT DRAFTS OF FALL RISK ASSESSMENT TOOL

It was done by experts' opinion. The fall risk assessment tool was circulated among the nine experts i.e. from different nursing specialties, medicine and surgery to acquire suggestions by keeping in mind relevance of item to the subject of study; items were meaningful and easily understandable, items measures the risk factors causing falls and items were observable in hospital setting.

Modification after First Delphi Round

Majority of experts suggested reviewing more risk factors associated with falls. The tool earlier had six categories then after incorporating the expert's suggestions it was increased to twelve categories.

Items added:
- **Gait abnormalities:** Sub categories included under this were nil, mild, moderate and severe.
- **Use of walking aid:** Under this sub categories included were none, walking stick, crutches, wheel chair.
- **Secondary diagnosis related to CNS, CVS:** It was categorized as none of the secondary diagnosis was present, only one present, two present, three or more than three present.
- **Continence:** Continent, increased frequency, nocturia and urge incontinence were included under this category.
- **Environmental conditions:** Subcategories included under this were Poor lightning/glaring of vision, Inappropriate foot wear, Bed height, Slippery floor, Appropriate distance between beds; Obstacles on the way present or not.
- **History of fracture of lower limb:** Fracture of lower limb had occurred one week before, two weeks before, three weeks before, nil or four weeks before.

Items modified:
- **Mental state:** Options were modified to normal, confused, disoriented and agitated.
- **Sensory perception:** Options were modified to no impairment, slightly limited, very limited, completely limited.
- Written key was also framed to ascertain the objectivity in scoring the risk factors, in respect of each patient.
- Earlier scoring of the fall risk assessment tool was done as 0, 1, 2 and 3 but now scoring was modified as 1, 2, 3, and 4.
- The maximum score was modified as 48 and minimum score as 12.

MODIFICATIONS AFTER SECOND DELPHI ROUND:
Items modified:
- **Medications:** Risk factor antihypertensive, vasodilators and diuretics were modified as cardiovascular drugs
- **Use of walking aid:** Wheel chair was given score of 2 instead of 4; crutches/ walker users were given a score of 3 instead of 3 and 4. As it was suggested by majority of the experts and reviewed from literature that the patients using wheel chair were having low risk of fall from those who were using crutches/ walker.
- **Secondary diagnosis related to CVS or CNS:** Diagnosis contributing falls were specified in the key
- **Environmental conditions:** Inappropriate foot wears and bed height were defined in the key; Minimum distance required between beds to prevent falls was mentioned in the tool
- **Sensory perception:** Score of 1 was given to normal instead of no impairment
- **Fracture of lower limbs:** Score of 1 was given to nil, 2 to nine or more months before, 3 to six months before and 4 to three months before

Items added:
- **Medications:** Sedatives, hypnotics and anti psychotics were added under medications. As it was reviewed from the literature that patients using these medications were at a higher risk for fall.
- **Use of walking aid:** Score of 4 was given to furniture/ wall users

MODIFICATIONS AFTER THIRD DELPHI ROUND:
Items modified:
- Scoring of each item was mentioned in the column heading rather than along with the risk factor.
- **Fracture of lower limb:** sub categories under this were changed from nil/four weeks before to nil/ >9months, three weeks before to 7-9months, two weeks before to 3-6months and one week before to <3months. As reviewed from the literature that the patients having fracture in < 3months were at highest risk of fall.
- **Modifications done in key**:
  - ➤ **Mental state:** The agitated patients were clearly defined.
  - ➤ **Continence:** Duration of patients with increased frequency of urination was mentioned.
  - ➤ **Continence:** The term nocturia was specified.

Items added:
- **Medications:** classification of each category of medications was described.
- **Walking aid:** score of 1 was given to both, none/ bed rest and a score of 2 was given both to wheel chair/ nurse assisted.
- **Continence:** score of 1 was given to both continent/ catheterized patients**.**

PHASE 3 PILOT STUDY

It was conducted to ensure the feasibility of the study. The data was collected by observing the 10 patients from medicine ward of MMIMS&R Hospital and scoring was done on fall risk assessment tool. The other necessary details were collected and recorded from the patient's file.

Results of the pilot study shows that the tool was feasible for final data collection, language of the tool was easily understandable & clear, and took 10-15min

PHASE 4 TRY OUT OF FALL RISK ASSESSMENT TOOL:

The final fall risk assessment tool was administered during the month of January 2013 in medicine and surgery wards of MMIMS&R Hospital, Mullana, Ambala. The data was collected from the 200 patients admitted in the wards.

RELIABILITY AND VALIDITY OF TOOL:
RELIABILITY:
    a) Internal consistency:
      Internal consistency was calculated by Cronbach's alpha. The Cronbach's alpha coefficient for the developed tool was found to be 0.75 (for the tool to be reliable, the Cronbach's alpha should be equal to or more than 0.7)

Cronbach's alpha if item deleted:
    To check the individual contribution of items, each item was deleted one by one to see the changes in the value of Cronbach alpha coefficient. But none item had shown increase in the value of Cronbach alpha coefficient rather the value of Cronbach alpha coefficient remained same or it decreased (table-1) which indicates all the items were contributing in the tool. Even on deleting items having item to total correlation less than 0.2, the value of Cronbach alpha did not increase. This indicated that all the 12 items were contributing for the reliability of the tool. It meant that tool was internally consistent by taking all 12 items.

Table -1 : Reliability analysis of Fall Risk Assessment Tool by using Cronbach's alpha

Items of Scale	Scale mean if item deleted	Corrected item total correlation	Cronbach's alpha if item deleted
Age	18.39	.533	.711
Fall history	19.04	.387	.733
Mental state	18.83	.502	.714
Sensory perception	18.24	.544	.706
Medication	18.63	.478	.719
Patient care equipment	18.50	.102*	.757
Gait	18.10	.507	.713
Use of walking aid	18.48	.395	.732
Secondary diagnosis related to CVS and CNS	18.78	.489	.717
Continence	18.35	.348	.739
Environmental condition	17.92	.137*	.753
Fractures of lower limbs	19.20	.139*	.750

  *Items in the tool which shows item to total Correlation <0.2
    b) Interrater reliability :
    Equivalence in the context of reliability assessment primarily concerns the degree to which two or more independent observers or coders agree about scoring. For this the inter rater reliability was calculated by cohen's kappa and was found to be 0.84 for the fall risk assessment tool signified that percentage of agreement was 84%. (for some agreements the value of 0.60 is minimally acceptable and with values of 0.75 or higher are considered very good) [10]

VALIDITY:
a) **Face validity**
    It promotes validity through the assumption of a logical tie between various items and the research area. The practical tool in the assessment of face validity is an expert panel; by seeing the tool majority of experts suggested that all the risk factors for Fall Risk Assessment Tool are well organized and structured. Thus the face validity of the tool was considered good.

b) **Content validity:**
    Content validity of fall risk assessment tool was checked by calculating the content validity index (CVI) through the Performa which was filled by the experts. Content validity index was came out to be 0.94 (values of CVI higher than 0.78 are considered having good content validity) [10] signifying that tool had a good content validity.

c) **Concurrent validity:**
    Concurrent validity of fall risk assessment tool was checked by calculating Pearson correlation in between the fall risk assessment tool and Morse Fall Scale. Data was collected from 36 patients with the help of both tools. Through this Pearson's correlation came out to be 0.70; signifying that there was moderate correlation between both the tools.

d) **Predictive validity:**
    The predictive validity at each score was calculated by sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) tests (Table -2). It reveals sensitivity, specificity, positive predictive value and negative predictive value tests of the risk assessment tool for prediction of falls, and these were calculated at each score from 14 to 31. Sensitivity was ranged from 1% to 100%, specificity from 28.5% to

100%, positive predictive value from 1% to 99% and negative predictive value from 1% to 99%. At a cut-off point of ≥ 18, the best balance between the sensitivity and specificity was achieved, i.e. sensitivity was 26.42%, specificity 85.71%, positive predictive value 26% and negative predictive value 74%. Since cut-off point of the tool was 18, patients who were having a score ≥ 18, were at risk for falls.

Table -2: Sensitivity, Specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) tests.

Cut -off point Total score	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
≥14	1.00	100.00	1.00	99.00
≥15	4.66	100.00	4.50	95.50
≥16	11.91	100.00	11.50	88.50
≥17	19.17	100.00	18.50	81.50
≥18	26.42	85.71	26.00	74.00
≥19	18.13	85.71	18.00	82.00
≥20	56.99	57.14	56.50	43.50
≥21	65.80	42.85	65.50	34.50
≥22	19.68	71.42	20.00	80.00
≥23	82.38	28.57	82.00	18.00
≥24	86.01	28.57	85.50	14.50
≥25	88.60	28.57	88.00	12.00
≥26	85.49	28.57	85.00	15.00
≥27	86.01	28.57	85.50	14.50
≥28	89.63	28.57	89.00	11.00
≥29	90.67	28.57	90.00	1.00
≥30	99.48	28.57	98.50	1.50
≥31	100.00	28.57	99.00	1.00

III. Discussion:

Patients falls remains the most common adverse event reported in hospitals resulting in mortality, morbidity and fallophobia. Problems with falls were also associated with significant costs for society. Identification of patients at risk for falls is perhaps the most important issue in falls prevention. The investigator developed a risk assessment tool for the prediction of falls in patients, which was composed of 12 risk factors including age, previous falls history, mental state, sensory perception, medications, patient care equipments, gait, use of walking aid, secondary diagnosis related to CVS and CNS, continence, environmental factors and fracture of lower limb. Similarly Hendrich et al studied medical records of 102 patients who fell and 236 control patients in general acute care hospital and found seven significant risk factors: history of falls, depression, altered elimination, dizinees/vertigo, cancer diagnosis, confusion and altered mobility[11]. Watson and Mayhew studied 77 patients who fell and 77 controls patients in long term care population. They found four factors to be significantly associated with falling: impaired mobility, visual impairment, restrain orders and use of hypertensive medications. Gluck and co-workers studied 50 elderly (>75 years of age) patients who fell and 50 controls and found these significant risk factors: the presence of confusion and disorientation; and incontinence, diarrhea and requiring help to toilet.[12]Morse studied 100 patients who fell and 100 controls in a 1200 bedded urban hospital. She found six significant risk factors: history of falling, presence of secondary diagnosis, use of ambulatory aid, intravenous therapy or heparin lock, impaired gait, and poor orientation of patient to his/ her own activity. According to the different cut-off scores, the sensitivity ranged from 91.5 to 38.3%, the specificity from 81.7 to 10.9%, the PPVs from 12.5 to 22.5% and the NPVs from 90.2 to 95.7%. [13]

Reliability of fall risk assessment tool consists of internal consistency (coefficient alpha & Item-item correlation) and equivalence (inter rater reliability). Coefficient alpha was 0.75 (p<0.001) and item-item correlation was moderate (0.34-0.54) except patient care equipments, environmental conditions and fracture of lower limbs were weakly correlated (< 0.30) with certain items. For equivalence inter rater reliability was calculated by cohen's kappa and was found to be 0.84 signifying that percentage of agreement was 84%. Similarly Bergstrom et al. examined the reliability coefficient between registered nurses and graduate students and the percentage of agreement measuring was 88%.[14]

Validity of fall risk assessment tool consists of content validity, concurrent validity and predictive validity. Content validity of was checked by calculating the content validity index (CVI) through the Performa which was filled by the experts and was came out to be 0.94. Concurrent validity was checked by calculating Pearson correlation in between the fall risk assessment tool and Morse Fall Scale and it was came out to be 0.70. Predictive validity was calculated by sensitivity, specificity, positive predictive value and negative predictive value tests. These were calculated at each score from 14 to 31. Sensitivity was ranging from 4.6% to 100%, specificity from 1% to 100%, positive predictive value from 1% to 99% and negative predictive value from 1% to 99%. At a cut-off point of ≥ 18, the best balance between the sensitivity and specificity was achieved, i.e.

sensitivity was 26.42%, specificity 85.71%, positive predictive value 26 % and negative predictive value 74%. Since cut -off point of the tool was 18, patients who were having a score ≥ 18, were at risk for falls.

Nursing implications:

The nursing administrators can make effort to involve the fall risk assessment tool with the treatment chart of the patients. Through in-service education programme all bedside nurses can be trained to use fall risk assessment tool for all the in-patients. The tool can be used in different clinical areas to assess the at risk patient and thereby helps in prevention of falls in hospitals. It helps as a reminder for nurses of the possibility of falls so early preventive measures can be used for those who were at risk. It would make it possible to identify those patients who really need immediate preventive measures. Risk assessment tool helps to reduce cost and duration of hospitalization of critically ill patients. The present study would generate scientific literature for trained as well as student nurses and serve as a baseline in developing more valid risk assessment tool for the prediction of falls in different settings. The study can be utilized in clinical to assess prevalence of falls in various units.

Hence it was recommended that tool can be implemented on a large sample and for a longer duration. Feasibility of tool can be assessed at different settings for calculating sensitivity and specificity to establish appropriate cut-off points. Comparative studies can be conducted to establish predictive validity by using present risk assessment tool versus standardized tool (Morse Fall Scale, Hendrich II Fall Risk Model etc). Standards or protocols on preventive measures for falls among the high risk patients can be developed based on the identified risk factors.

Limitations
* Incident reporting of falls was not standardized.
* Discharge rate of patients was more so the follow up for most of the cases couldnot be done.

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