A Simplified Fall-Risk Assessment Tool for Patients Hospitalized in Medical Wards

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Abstract

Background: Falls are a common problem among hospitalized patients, having a significant impact on quality of life and resource utilization.

Objectives: To develop and validate a fall-risk assessment tool for patients hospitalized in the department of medicine that will combine simplicity with adequate accuracy for routine use.

Methods: This observational cohort study was conducted on the medical wards of an urban tertiary teaching hospital, and included all patients who fell in the medical wards during a 1 year period (n=140) compared to other hospitalized patients.

Results: Significant correlates of falls were previous falls, impairing medical conditions, impaired mobility, and altered mental state. In multivariate logistic regression analyses, only previous falls (odds ratio 3.8 with 95% confidence interval 2.65–5.45, $P < 0.0001$) and acute impairing medical conditions (OR 1.56, CI 1.06–2.29, $P < 0.05$) correlated independently with a higher risk for falls. Impaired mobility retained an OR of 1.46 (CI 0.95–2.24, $P = 0.084$). Accordingly, defining patients with either a history of previous falls or both acute impairing medical state and impaired mobility as fall-prone patients provided a sensitivity and specificity of 67% and 63%, respectively. In a subsequent prospective validation trial on 88 patients who fell during hospitalization and 436 controls, the sensitivity and specificity of this fall-risk grouping were 64% and 68% respectively.

Conclusions: Our new simple and easy-to-use fall-risk assessment tool identified most of the fall-prone patients. These findings suggest that this tool may enable us to prevent two-thirds of falls on the medical ward by providing effective fall-prevention facilities to only one-third of the patients.

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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. According to one study, patients who fell were hospitalized for 12 days longer and had charges U.S. $4233 higher than controls [7].

Determination of risk factors leading to increased incidence of falls, and, hence, recognition of the patients at increased risk, is mandatory for a successful fall-prevention program. However, this task is far from simple. According to one review, over 400 potential medical and environmental risk factors are associated with increased incidence of falls occurring at home or outdoors [8]. Many of these risk factors cannot be evaluated on a routine clinical basis due to difficulties in identification without special equipment or the need for specific diagnostic skills or detailed examination. Although several studies have shown that a few readily assessable risk factors may predict a large proportion of patients prone to falls [9-13], the accordingly developed assessment tools require calculation of a score derived from a questionnaire, a task that is seldom performed. Moreover, risk factors and their scores vary and need to be validated, depending on location and the type of patients, i.e., at home, geriatric facility, hospital, etc. Even within the hospital, substantial differences between medical, surgical, obstetric and other wards are expected. A recent systematic review that studied the validity and reliability of 38 fall-risk assessment tools concluded that some of these tools show moderate to good validity and reliability. However, since few tools were tested in more than one facility, no single tool can be recommended for implementation in all facilities or for all subpopulations within each facility [14].

A common handicap of most in-hospital fall-prevention programs is their failure to demonstrate a convincing reduction in the number of falls among patients identified as prone to falling, once optimal general precautions (low beds, locked brakes, etc.) are already implemented [13,14,16]. We believe that patients at high fall risk, particularly on the medical wards, should be concentrated in a few designated rooms that have special fall-prevention measures. For this purpose, a tool to identify fall-prone patients should be simple and easy to use in order to enhance implementation and compliance. We hypothesized that focusing questionnaires to specific populations (i.e., hospitalized patients on specific floors) may enable personnel to simplify the identification of fall risk. In previous surveys in our hospital we noticed that about two-thirds of all in-hospital patient falls occurred on the medical wards. The aim of the current study was to develop and validate a simple and accurate fall-risk assessment tool for patients hospitalized in the department of medicine, which can be used routinely for identifying patients in need of adequate fall-prevention facilities.

Patients and Methods

The study was conducted at the Bnai Zion Medical Center, an inner city 400-bed teaching hospital. All patients included in the study were hospitalized in three general medicine wards and one

OR = odds ratio
CI = confidence interval

neurology ward comprising 142 beds altogether. At the time of the study, general safety precautions were already integrated in fixed protocols inspected regularly by the nursing staff, including attention to bed brakes, bed height, call buttons, night lights, and other measures intended for all patients. The study included two phases: Phase 1 was designed to develop the fall-risk assessment characteristics. In phase 2 we validated our new simplified risk scale in a new group of patients and compared it to the Morse scale, an often-cited more general fall-risk scale [10].

Based on previous studies [7,10,13,18] and the experience in our hospital, we grouped the most important factors associated with an increased risk of falling into five risk factor categories:

- Previous fall(s) in the last 3 months (not due to tripping over obstacle, etc.)
- Confusion or altered mental state (answers to simple questions are unrealistic or inconsistent)
- Impaired mobility (due primarily to neurological and orthopedic diseases, but also vertigo of any cause, orthostatism and severe vision disturbance)
- Use of a walking aid (including wheelchair)
- Acute impairing medical conditions expected to cause new functional impairment, orthostatism and hypotension, as well as dizziness or disorientation (including fever, dehydration, uncontrolled diabetes mellitus, hemorrhage, anemia, sedative drugs etc., all considered by the nurse to be severe enough to affect the patient's stability).

Each of these five risk factors was further divided into two levels of severity and were used as a checklist for fall-risk assessment [Figure 1].

All patients' falls are regularly reported in our hospital on "event forms," which include a description of the event by a nurse, and a physician examination. A fall is defined as an incident in which the patient involuntarily fell on the ground or other surface, independently of any injury suffered. We consider a fall to have occurred if the patient was seen falling, was found on the floor, or reported having fallen. For the purpose of the present study, all nurses received detailed instruction about the purpose of the study and how to fill out the five-point, three-level (0,1,2) fall-risk assessment forms. Data were collected over a whole year. During the first 2 months, forms were filled for every patient admitted to a medical ward (with the exclusion of fully immobile, bedridden patients not expected to fall). Since only 2.1% of the patients fell during hospitalization, almost all patients during this period belonged to the control group. These patients were considered to represent our admitted population over the whole year. After the initial 2 months, the fall-risk assessment forms were filled only for patients who fell (the few patients who fell more than once were counted only once), immediately after the fall, retrospectively, i.e., the nurses were instructed to complete the form as they would have done before the fall, not including any handicap caused by the fall itself.

After the completion of phase 1 and defining our simplified fall-risk assessment tool, we evaluated its accuracy in a phase 2 trial. The same fall-risk assessment form was filled out for all admitted patients during one month, and for all patients who fell during the next 8 months. The data obtained were used to assess the sensitivity and specificity of the new scale derived from phase 1. In parallel, a slightly modified Morse scale [10] was also calculated for all phase 2 patients. The presence of secondary diagnosis and peripheral venous cannula, both considered to represent risk factors in the Morse scale, were omitted since these parameters were present in almost all of our patients. Three levels of the Morse scale scores were used to compare patients who fell with those who did not, to assess the best cutoff. The specificity and sensitivity of our scale was compared with those obtained by the Morse scale.

Figure 1. The fall-risk assessment form used in this study. Each risk factor was divided, when present, into two levels of severity

Bnai Zion Medical Center – Department of Medicine

Ward..... date.....

Fall-risk assessment form

Patients' sticker

1. A history of previous fall(s) Within the last 3 months, not due to obstacle, etc.	None	One	More than one
2. Impaired mobility Including neurological causes (CVA, Parkinson, etc.) Orthopedic causes (articular/bone diseases), dizziness, orthostatism, vision disturbance, etc.*	None	Moderate	Severe
3. Use of walking aid	None	Walking stick	Walker or wheel chair
4. Confusion or altered mental state including dementia and other psychiatric disorders	None	Moderate	Severe
5. Impairing medical condition including temperature > 38ºC, infection, arrhythmias, anemia (Hgb < 9 g/dl), uncontrolled diabetes, sedative drugs, etc.*	None	Moderate	Severe

* At a level expected to increase fall-risk

Name of nurse.....

Statistical analysis

Chi-square test was used to compare the cases and control group, and logistic regression analysis was used to identify independent predictors of fall, including risk analysis. A simple scoring of the independent risk factors was used to calculate the combination of risks that provided the best and most practical distinction between patients who fell and those who did not.

Results

During the first year study period (phase 1) the total number of patients admitted to the medical wards was 6654; the prevalence of their risk factors was calculated from the data of all patients who were admitted during the first 2 months and did not fall during hospitalization (N=1128). During that year 140 patients in the medical wards fell, constituting 68.6% of the 204 falls reported that year in the hospital, and 2.1% of all patients admitted to the department of medicine. These patients differed significantly ($P < 0.0.1$) from those who did not fall: they were

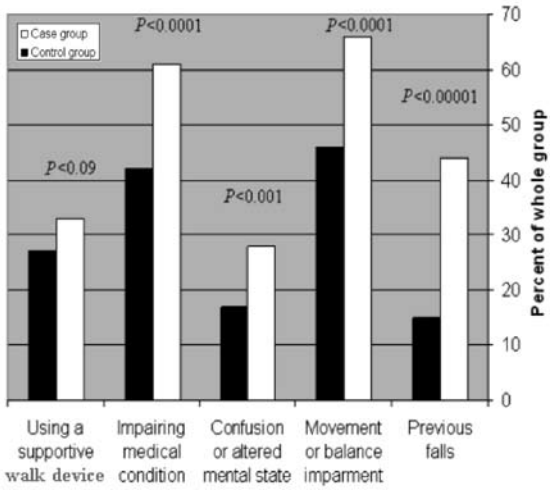

Figure 2. The prevalence of risk factors in the case group (patients who fell during hospitalization) and control group. *P* values were calculated with univariate analysis.

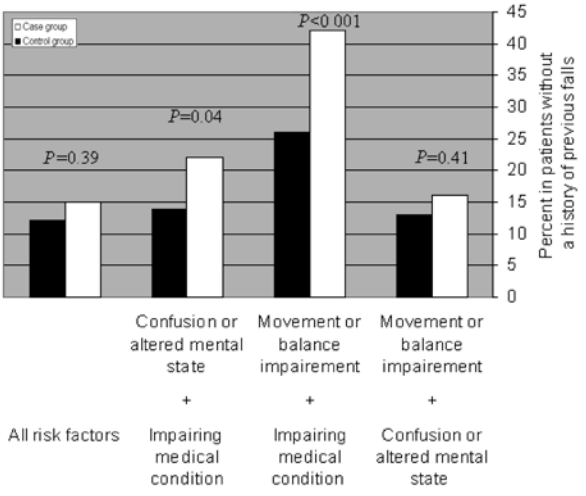

Figure 3. The prevalence of combinations of risk factors in case and control groups in the patients without a history of previous falls.

older (70.3 ± 5.8 vs. 67.6 ± 6.8 years), were hospitalized longer (6.0 ± 4.3 vs. 4.3 ± 3 days), and included more men (44% vs. 38%). Almost all falls occurred in the patients' rooms and bathrooms, and 63 (45%) occurred at night. Injuries included 2 bone fractures and 5 wounds that required suturing; after 10 falls head CT was performed.

On first analysis, all risk factors were significantly more common in the patients who fell during the hospitalization (case group), with the exception of using a walking aid [Figure 2]. In multivariate logistic regression analyses, only two factors were independently correlated with higher risk of falls: previous falls (odds ratio 3.8 with 95% confidence interval 2.65–5.45, $P < 0.0001$) and impairing medical conditions (OR 1.56, CI 1.06–2.29, $P < 0.05$). Mild to moderate movement or balance impairment was only borderline significant (OR 1.46, CI 0.95–2.24, $P = 0.084$). Confusion and altered mental state did not pose an independent fall risk, and the use of supportive moving devices tended to decrease the risk. In addition, separate consideration of the more severe levels of fall risks did not help to distinguish between patients who fell and those who did not. With the exception of multiple previous falls, patients with a higher level of severity of the other independent risk factors tended to be at lower risk [Table 1].

Table 1. Multivariate analysis of risk factor correlation with the incidence of falls

Risk factor	Severity	Odds ratio	Confidence interval	*P*
History of recent falls	One	3.67	2.43–5.53	< 0.0001
	More	4.06	6.78 -2.42	< 0.0001
	Total	3.80	2.65–5.45	< 0.0001
Impairing medical conditions	Moderate	1.68	1.14–2.48	0.009
	Severe	1.11	0.57–2.17	0.76
	Total	1.56	1.06–2.29	0.022
Impaired mobility/balance	Moderate	1.46	0.95–2.24	0.084
	Severe	1.32	0.69–2.52	0.41
	Total	1.42	0.93–2.17	0.11
Confusion or altered mental state	Moderate	1.24	0.75–2.06	0.41
	Severe	1.56	0.86–2.83	0.15
	Total	1.24	0.82–1.87	0.31
Using a supportive walk device	Walking stick	0.81	0.51–1.28	0.36
	Walker or wheelchair	0.79	0.45– 1.37	0.40
	Total	0.78	0.52–1.15	0.21

Each one of the five risk factors (or risk factor groups) was evaluated both at two levels of severity, and when both levels were combined (total).

The aim of the present study was to define a simple combination of risk factors that will identify most patients who, without special care, will fall in the hospital, with the smallest possible false positive group. We considered every patient with a history of a recent fall as being at high risk for repeated falls. However, these patients were only 44% of the patients at risk. Combining this group with all patients considered to have impairing medical conditions totaled about 80% of all patients at risk, but also required special attention to half of the hospitalized patients. However, combining only patients with both movement impairment and impairing medical states gave the best results, identifying 42% of cases compared to 26% of controls ($P < 0.001$) [Figure 3]. Accordingly, a risk-assessment tool was derived by defining two groups of high risk patients: those with a history of previous falls and those without previous falls but with movement or balance impairment and impairing medical conditions. The sensitivity and specificity of our assessment tool was 67% and 63% respectively. In other words, providing successful fall-prevention facilities to 37% of the hospitalized patients on the medical floor will be of benefit to 67% of the patients expected to fall without these measures.

In Phase 2, the accuracy of our assessment scale was evaluated. Altogether, 88 falls were reported over the 9 months evalu-

ated, and 436 controls were recruited. Our simplified assessment tool predicted 64% of the falls (sensitivity 64%, specificity 68%). The modified Morse scale separated best between cases and controls using a threshold score of 25. At this level, it predicted 57% of the falls (sensitivity 57%, specificity 73%).

Discussion

The present study evaluated risk factors for in-hospital falls, specifically for patients hospitalized on medical wards. The main findings were as follows: a) there are three easily obtainable parameters – previous falls, the combination of movement impairment, and acute disabling disease – that can identify high risk patients prone to fall just as accurately as more complicated questionnaires that require calculation of scales and scoring; b) providing adequate fall prevention measures to a third of admitted patients should help prevent falls among two-thirds of the patients expected to fall during the hospitalization without such facilities.

Although the literature has sought to describe fall-risk profiles, the accuracy of risk-assessment tools in predicting falls needs further evaluation in specific clinical groups because of variations in clinical practice, environmental risk and case-mix. The present study demonstrated several advantages when compared to similar previous studies:

- Most of the previous studies were conducted in outpatient settings, chronic care facilities or elderly care units. In hospitalized patients, the acute illness leading to hospitalization increases the risk of fall due to weakness, immobility, metabolic disorders or the addition of new drugs. In the attempt to develop a general fall-risk assessment tool, insufficient weight has often been given to the impact of the acute disease.
- The occurrence of falls depends on the type of patients and hospital service characteristics, and falls and fall risks are likely to differ substantially between, for example, the department of obstetrics and the geriatrics ward. It is essential, therefore, to evaluate fall risk in the setting of specific departments, and the present study addresses specifically the department of internal medicine, where most falls occur.
- The majority of previous studies were retrospective, relied on data from medical records, and were not prospectively validated. According to Oliver et al. [12], more than 40 articles published in the literature mentioned fall-assessment tools, but only two risk-assessment tools fulfilled the criteria of prospective validation.
- Inclusion of all admitted patients (rather than a chosen control group) enabled estimation of the true percentage of admitted patients in need for special fall-prevention measures.
- Estimation of the fall-risk parameters used in the present study was performed by the regular nurses working in the department, rather than specialized staff with special diagnostic skill or training. Future estimates are likely, therefore, to resemble the ones on which our tool is based.
- Many fall risks are interrelated. Nevertheless, adequate statistical analysis to identify independent risk factors was performed in only a few studies, resulting in excessive identification of risk factors. In the present study we were able to narrow the number of important risk factors substantially, once regression analysis was performed.
- By assessing a specific group of patients, we were able to develop a very simple and easy-to-use fall-risk assessment tool, which performed as well as previous more complicated ones, while being free of long questionnaires and the need for summation score. Comparison of previous fall-risk assessment tools (STRATIFY, Downton, Tullamore, and Tinetti) revealed that STRATIFY gave the best results, with predictive accuracy of 66%, comparable to 64% in our study [13].
- The current findings are valid for patients, staff and conditions in Israel, and may be more useful than those evaluated in other countries.

Our study has several potential limitations, some of which derive directly from issues considered to represent advantages. The findings are valid for patients hospitalized in medical wards only. Although most of the in-hospital falls occur in these wards, specific tools for other departments need to be developed. Secondly, much weight was placed on risk factors that cannot be defined accurately (like acute disabling medical state and impaired mobility), leaving the nurses a subjective degree of freedom. Interpersonal variation in judgment could have substantial influence on the results. However, such differences in opinion are unavoidable in routine work, and occur also with more standardized questionnaires. More important, we believe that the experience of the nursing staff is useful in estimating patients' fall risk, and should be integrated in the evaluation in a structured fashion. This concept was recently confirmed in a meta-analysis, which concluded that the more sophisticated scoring tools are unlikely to generate benefits significantly greater than the clinical judgment of the nursing staff [20]. Thirdly, the risk factors of the case group were estimated retrospectively, shortly after the fall occurred. This fact could affect the nurses' assessment, causing some of them to interpret items based on clinical judgment as either more or less severe. Fourthly, all falls occurring during the study period were included, independently of the occurrence or severity of injury. Since the severity of injury during a fall is often incidental, we believe that this approach is justified. Also, the few patients who were seriously injured during their fall did not seem to differ from other patients who fell. Finally, the sensitivity and specificity of our (and other) fall-risk assessment score is relatively low. This seems to be unavoidable, however, as most (> 94%) of the high risk patients do not fall during a short hospitalization; on the other hand, unexpected falls among patients with minor or unrecognized risk factors are not rare.

In agreement with previous similar studies conducted in the hospital acute setting [14, 21,22], the most important risk factor in our study was the history of recent fall(s). The risk factor termed "impairing medical condition" was usually divided in

previous studies into a variety of specific diagnoses. In its current version, it was also independently associated with falls, and was most important in patients without a history of previous falls. On the other hand, impaired mobility was found to be only borderline significantly correlated to falls, and other "classic" risk factors, like altered mental state and use of a walking aid, were not helpful when using the regression model. In addition, dividing risk factors into severity categories did not provide a statistical or practical advantage and even worsened the predictive value of some risk factors. This apparently paradoxical finding is likely due to the fact that the nursing staff, patient's family, and even the more severely impaired patients themselves were more aware of the risk of falling and were better protected. For the same reason, most probably, the fall risk of patients with three risk factors on our wards was rather low. This contrasts to findings in elderly people living in the community, for whom the fall risk increases progressively with increasing number of risk factors [23].

Previous in-hospital fall-prevention programs usually aimed to decrease environmental or extrinsic risks for all patients. Studies often failed to demonstrate a convincing reduction in the prevalence of falls [16,17], and the low rate of risk reduction observed in a few studies could have been biased by the use of historical controls [24]. According to the Australian government review on the analysis of research on preventing falls and fall injuries published in 2004 [25], a wide variety of intervention strategies aimed at reducing the occurrence of falls was proposed, including education, exercise, and environmental modifications. To date there are no randomized controlled trials investigating the effectiveness of environmental modifications, and only a few studies utilizing primarily descriptive or retrospective methodologies. We believe, therefore, that future efforts should focus on the use of more sophisticated devices, such as advanced electronic alarms that warn when high risk patients attempt to leave their beds without needed assistance. The simple and fast, unit-based fall-risk assessment approach developed in this study should facilitate the identification of fall-prone patients and the triage to specially equipped rooms upon arrival to the ward. Based on our findings, providing adequate and successful monitoring to 37% of admitted patients can prevent about two-thirds of in-hospital falls.

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