Assessing the Safety Level of Hospitalized Patients: Analyzing Patient Activities

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Received: 04 Jan. 2024; Accepted: 02 Aug. 2024

Abstract- One of the important issues in health care systems that affect safety-related behaviors and reduce medical errors is to improve the safety level of the hospitalized patients. The aim of this study was to evaluate the level of safety of the hospitalized patients by analyzing the patient's activities. In the present study, all activities of the hospitalized patients were considered as one job, and the occupational safety analysis technique was used. For this purpose, all the activities of hospitalized patients from the time of entering the hospital to the time of leaving the hospital were identified and by forming a team of specialists in the field of patient care, a list of all possible risks in different stages of patient activities was determined. To assess the risk, the risk matrix model, which is one of the risk assessment models, was used. Experts' opinions were used to rank the risk, and finally the risk level of the identified hazards was determined before and after the control measures. The results showed that the risks in 6 stages for the patient include the patient entering the hospital, patient admission in the ward, patient entry into the room, hospitalization in the room, patient transfer for medical and diagnostic purposes and patient discharge from the hospital. There are a total of 79 potential hazards. The results showed that by managing the four types of risks "Struck against", "Fall to below", "Fall same level", "Struck by", which are among the most important risks that threaten the hospitalized patients, more than 50% of potential risks is reduced. The findings showed that the recurrence and severity of risk and, consequently, the level of risk identified in different stages of hospitalization are different. Therefore, improving the level of management and prioritization and providing the controlling and the suggested solutions, which are the main management tasks in a hospital, can improve the safety of the hospitalized patients.

Acta Med Iran 2024;62(September-October):236-246.

Keywords: Safety; Patient; Risk; Falling

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Introduction

The concept of patient safety is one of the main bases of health care systems, that is necessary to improve the quality of patient care and reduce the likelihood of dangerous events and reduce the costs of patient health care (1,2). The right to be safe from harm and injury, while receiving health care is one of the most prominent human rights. Waging cooperation to develop and identify the solutions for patient safety, the World Health Organization (WHO) established the World Union in 2007 (3,4). One of the topics that has attracted more attention in the world in the field of patient control and safety is the Never event (5). According to the Never Events instructions, patient safety is an important issue for which the global efforts have been underway since 2004 in order to improve health care safety for patients (6). Therefore, to identify potential safety risks in the patient, risk assessment and analysis is needed (7). The Department of Health and Human Services Office of the Inspector General (OIG) found in 2008 that 27% of hospitalized patients during their stay in Hospitals have had "accident" or "temporary injury" incidents. And it is estimated that approximately one-fourth of all hospitalized patients still experience complications and adverse events (8,9). For example, studies show that falls occur in about 40% of patients during hospitalization (10) 44% of the falls were related to falling out of bed and the other cases included falls in toilets, corridors, and out of the wards, respectively (11) so studies have shown that in addition to being patient-centered, being timely, effectiveness, efficiency and justice, the patient safety is an important aspect of the quality of health care and the patient's safety situation in hospitals needs to be improved (12,13). Researches have revealed that there are a number of systems-related safety challenges, in which development of patient safety will help healthcare providers and organizations identify the risk and seek solutions to address it (14,15). Paying attention to patient safety is an important issue in providing hospital services and any shortcoming in it can have negative consequences (16). In order to achieve patient safety, it is necessary to measure the patient's level of safety, in the first step. On the other hand, in this regard, WHO has recommended to hospital managers, planners, officials and administrators to design change programs in hospitals and trainings related to patient safety culture in order to strengthen the culture of patient safety protection and to reduce the errors (17,18).

Although, a wide range of methods for assessing the quality and safety of inpatient care, including staff and patient approach investigation, Delphi methods (15,19,20) and retrospective methods such as root cause analysis are often used in clinical care (21) there may be more passive and active risks for hospitalized patients in various areas. As Reason's model states, several factors such as management factors, organizational work environment, team factors, task factors, and patient characteristics affect clinical performance and patient safety (22). In Iran, with the implementation of the accreditation plan by the Ministry of Health and Medical Education, in hospitals across the country, patient safety in health care centers has received special attention. According to this plan, risk management and improving the safety of patients in medical centers has been recognized as one of the main bases of clinical accreditation (23). And risk management in hospitals is one of the important issues in health care systems to reduce the vulnerability of hospitalized patients, and in this regard, safety assessment should be developed and implemented to create a safe environment for patients, in accordance with specific policies and procedures.

In line with the four phases of the accident management cycle (prevention phase, response preparedness phase, timely and appropriate response phase and recovery and reconstruction phase) and emphasizing the first phase of this cycle, one of the methods of accident prevention and risk analysis that can be important for effective management in the hospitals is analysis of the patient's activities, in order to intelligently detect and control the possible risks from the time of hospitalization until the patient is discharged. The main goal is to eliminate the risks that can lead to patient death, patient injury or even increase hospitalization time, transfer to special care section and increase of the hospital cost. Therefore, the present study was conducted to investigate all activities of the hospitalized patient by analyzing his/her activities in order to improve the patient's safety.

Material and Methods

This is a risk assessment study that was performed to analyze the patient's activities in order to determine the potential risks and safety level and provide a preventive and control strategy. In the present study, all activities of hospitalized patients were considered as one job; and the occupational safety analysis technique with the new name of patient safety analysis was used for hospitalized patients. Because this technique is one of the methods of

accident prevention and risk analysis and one of the important management tools that plays an crucial role in eliminating risks and reducing injuries and accidents (24,25).

For this purpose, all possible risks and non-medical accidents for hospitalized patients were identified by the presence of a 6-member team of experts with experience in safety and patient care (3ward nurses, a clinical supervisor, an HSE specialist and a medical equipment expert). Also 15 hospitalized patients (7 female patients and 8 male patients) were interviewed, in March 2017 in one of the teaching and medical hospitals affiliated to the Ministry of Health of Iran. The types of hazards and possible accidents were indicated by the letters a to k, which are described as follows:

a- Struck by: In this case, the patient is hit hard by an object, the contact force is from the stroke.

b- Struck against: In this case, a patient hits an object hard; the force is applied by the patient.

c- Contact by: The patient contact with objects and substances that are harmful by nature and cause injury.

d- Contact with: The patient meets harmful substances. In this case, the patient is the main agent and initiator of the contact.

e- Caught on: A patient or part of their clothing or accessories gets stuck on an object that is moving or stationary. This can cause the patient to lose his or her balance and fall, or suffer other injuries.

f- Caught in: A patient or part of his/her body sticks in a slit or compartment.

g- Caught between: A patient is placed between a moving object and a stationary one or between two moving objects.

h- Falling same level: A patient slips and falls while standing or walking on a surface.

i- Fall to below: A patient slips and falls on a surface below the level at which he stands or walks.

j- Over exertion: A patient exerts excessive pressure or commits kills himself, while performing work.

k- Exposure: The patient is exposed to predisposing factors over a period of time.

In order to assess the risk, one of the risk assessment models called the risk matrix model (26) was used. In this model, critical risk severity is divided into the three categories: first, Insignificant risk (less than injury), second, border crossing risk (medium injury), the third category (severe injury), this one is catastrophic risk (death). And the risk probability is divided into 5 levels, including: level one, unlikely (unlikely and can be assumed not to happen at all), level two, partial (unlikely, but may happen), level three, occasionally (sometimes occurring), level four, probable (occurs frequently), and levels 5, frequent (occurring repeatedly). They were displayed with the numbers 1 to 5 and 1 to 4, respectively, to determine the risk index of risk, probability and severity of risk. According to the probability and severity of the studied risk, and the occupied matrix cells, the resulting risk was determined (Table 1).

Table 1. Risk assessment matrix to assess the level of safety of hospitalized patients

Severity Probability	Insignificant (1)	border Crossing (2)	critica(3)	Disastrous (4)
Unlikely (1)	1	4	6	9
Partial (2)	2	7	11	13
Casings (3)	3	10	15	17
Probable (4)	5	12	16	19
Frequent (5)	8	14	18	20

In this method, experts' opinions are used to rank the risks. In the next steps, according to the decision criterion based on the risk matrix model (24) and in order to take corrective actions, the scores were classified as follows: Score 1-3: Acceptable without the need for revision-Score 4-11: Acceptable with the need for revision-Score 12-15: Undesirable and need to make a decision-Score 16-20: Unacceptable. In the matrix, the number 1 indicates the lowest risk, and the number 20 indicates the highest risk. In the end, we have prioritized the risks according to the Pareto principle. He states that when a number of factors affect a situation, a few factors will lead to a large effects (27) Pareto chart has been used for more clarity of information and in an organized way.

Results

The results showed that in 6 stages, including patient entry into the hospital, patient admission in the ward, patient entry into the room, patient admission in the room, patient transfer for treatment and diagnosis, and patient discharge from the hospital, and totally 79 potential hazards are faced by the patients, including: 13% risk of injury-20% risk of collision-1% risk of contact with dangerous objects or substances 5%-risk of sticking to the dangerous objects or substances 5%-risk of getting stuck in an object 9%-risk of getting stuck in a gap or chamber 8%-Risk of being between two things 1%-risk of falling to a level 14%-risk of falling down 19%-risk of overpressure 5%-risk of exposure 5% (Table 2). The total risks identified at different stages for the hospitalized patient are presented in figure 1, The results indicate that the greatest risks will occur in stage 4 when the patient is hospitalized in the room.

Table 2. Types of risks and possible non-medical accidents, to assess the safety level among the hospitalized patients

Operation code	Title of operation (job)	Struck by	Struck against	Contact by	Contact with	Caught on	Caught in	Caught between	Fall same level	Fall to below	Over exertion	Exposure	Total identified hazards
1	The patient enters the hospital grounds	3	4		1	1	1		2	3			15
2	Admission in the section	1	1		1	1	1		2				7
3	Enter the room		2			1			1				4
4	Hospitalization	2	2	1	1	2	1		3	5	2	4	24
5	Patient transfer for medical and diagnostic purposes	1	3			1	1	1	1	4	2		14
6	Leaving the hospital	3	4		1	1	1		2	3			15
Average potential risks		10	16	1	4	7	6	1	11	15	4	4	79

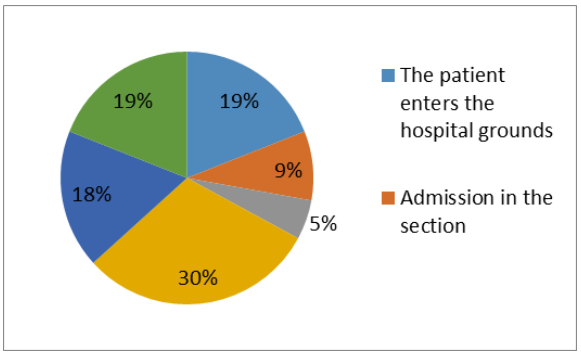

Figure 1. Total risks identified in different stages of hospitalization

At the stage of hospitalization of the patient in room, there are 24 possible dangers and accidents; so, the importance of monitoring various aspects is quite evident, including the risk patients' clinical situations; staff,

patients and accompanying people education; structure and spacing; and safe and accessible equipment. They are provided in the analysis form (Table 3), along with controlling and proposed measures. Examination of the results of risk assessment in different stages of hospitalization reveals that the frequency and severity of the risk and, consequently, the level of risk identified at different stages of hospitalization are different. All risks assigned to the patient had a score above 12 at the time of assessment, which showed a significant reduction in the risk level at all stages by providing controlling-preventive measures and after re-evaluating the potential risks (figure 2).

Pareto chart for better manage and heling the risk prioritization and potential accidents in the study showed that among the 11 types of hazards assessed, four types of risk are "Struck against", "Fall to below", "Fall same level", and "Struck by". There are dangers that threaten the hospitalized patient (figure 3) and examples of them are given in Table 3.

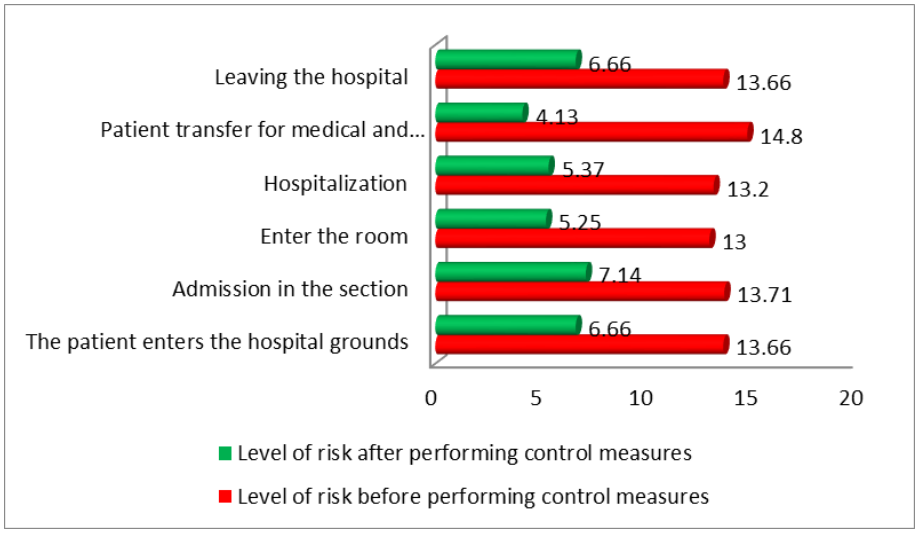

Figure 2. Potential risk assessment of the safety level of hospitalized patients

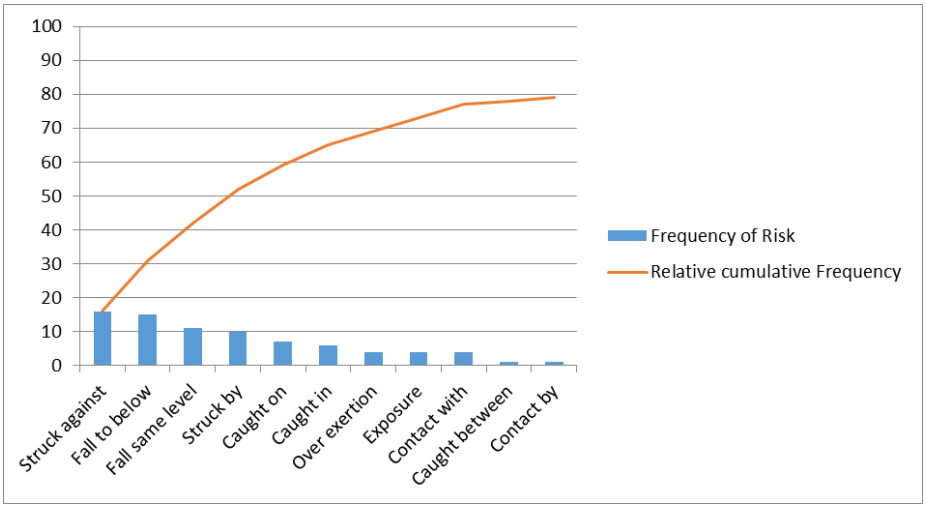

Figure 3. Frequency of potential risks to assess the safety level of hospitalized patients

Table 3. Analysis of risks and possible non-therapeutic accidents to assess the safety level of hospitalized patients

Activity Title: Hospitalizing Patients Required Courses: General Safety and Health Education for Patients and Staff, Occupational Safety Equipment								
The main steps of doing the job	**Risks or possible accidents**	**Level of risk before taking control measures**			**Proposed actions Suggested Control - Preventive**	**Level of risk after taking control measures**		
		Intensity	**probability**	**risk**		**Intensity**	**probability**	**risk**
Step 4: Hospitalization	4-1 Falling from the bed	4	4	19	4-1-1 Check the patient's consciousness, if he is aware of time and place 4-1-2. Consider the patients' age, especially those over 60 years of age and those under 60 years of age who have a history of falls 4-1-3. Check the patient's vital signs, regularly and be informed in case of changes 4-1-4. Consider the patient's weight condition and the appropriate bed 4-1-5. Examine the patient for addiction, alcohol consumption, and psychosis 4-1-6. Check the patient for dizziness and pain, regularly and control it with medication and complementary therapies. 4-1-7. Check the patient for nutritional status and malnutrition 4-1-8. Consider the effect of drugs on the patient, drug interactions, the effect of anesthetic drugs 4-1-9. Investigate the acute and chronic problems of the patient to prevent falls 4-1-10. Making stairs available next to the bed	1	3	3
	4-2 Slipping on stairs next to the bed	3	4	16	4-2-1. Stairs should be made of non-slip material 4-2-2. teach how to step on the stairs next to the bed	2	4	12
	4--3 Breaking the stairs next to the bed and falling ill	2	4	12	4-3-1. Stairs next to the patient's bed should be made of material that can withstand high weight 4-3-2. The height of the stairs next to the patient's bed should be standard	1	3	3
	4-4 -Breaking a chair and falling ill	3	4	16	4-4-1. Use a strong chair in the patient's room 4-4-2. Take the worn chair out of the room	1	3	3
	4-5-Excessive pressure and musculoskeletal problems during lifting	2	4	12	5-1. The wardrobe next to the patient's bed should be available to him 4-5-2. Necessary and essential tools should be available to the patient 4-5-3. Use of healthy tools and equipment with ergonomic features 4-5-4. Teaching the principles of ergonomics in the correct use of equipment 4-5-5. Cabinet wheels next to the patient's bed must be lockable	1	4	5

Cont. table 3

Activity Title: Hospitalizing Patients **Required Courses: General Safety and Health Education for Patients and Staff, Occupational Safety Equipment**								
The main steps of doing the job	**Risks or possible accidents**	**Level of risk before taking control measures**			**actions Suggested Control - Preventive**	**Level of risk after taking control measures**		
		Intensity	**probability**	**risk**		**Intensity**	**probability**	**risk**
Step 4: Hospitalization	4-6. Twisting the patient's foot and falling while walking in the room	2	4	12	4-6-1. Consider the patient's depression, anxiety, and stress 4-6-2. Consider the patient's sleep problems and offer a suitable solution 4-6-3. Check the patient's balance and movement from the time he enters the ward in different shifts 4-6-4. Check the patient for tremors in the limbs and taking objects in the hand 4-6-5. Check the patient for different clinical conditions	1	4	5
	4--7 Pulling the equipment connected to the patient, when getting out of bed	2	4	12	4-7-1. Check patient connections regularly 4-7-2. Teach the patient how to work with connections	1	4	5
	4-8. Falling from the toilet surface	2	4	12	4-8-1. Proper toilet should be provided to the patient 4-8-2. Necessary training should be given to the patient. 4-8-3. Appropriate handle rails should be installed next to the toilet	1	4	5
	4-9.The patient's clothes get stuck and the patient falls	3	4	16	4-9-1. Prepare patient clothes according to his/her size	1	3	3
	4-10 Slipping the patient's slippers and falling	2	4	12	4-10-1. The patient should wear appropriate shoes 4-10-2. Do not use tight and unprotected shoes	1	3	3
	4-11.Exposure to low light environment	2	4	12	4-11-1. Improve lighting 4-11-2. Check the patient's visual acuity, decrease night vision, disturbance in the patient's depth perception	1	4	5
	4-12. pressure and displacement of the bed	2	4	12	4-12-1. Make sure the flat brake is locked.	1	3	3
	4-13. Rapid movement of the patient due to frequent urination and dejecta	3	4	16	4-13-1. Check the patient's urinary frequency 4-13-2. Check the condition of dejecta for constipation or diarrhea	1	4	5

Activity Title: Hospitalization Patients; **Required Courses: General Safety and Health Education for Patients and Staff, Occupational Safety Equipment**								
The main steps of doing the job	**Risks or possible accidents**	**Level of risk before taking control measures**			**Suggested Control - Preventive actions**	**Level of risk taking after control measures**		
		Intensity	**probability**	**risk**		**v**	**probability**	**risk**
Step 4: Hospitalization	4-14. Being in an unfamiliar environment	2	4	12	4-14-1. Familiarity of the patient with the environment 4-14-2. In different shifts, check that the patient observes the necessary instructions and training	1	4	5

Cont. table 3

4-15. Facing unfamiliar equipment	2	4	12	4-15-1. Familiarizing the patient with the equipment used for him/her	1	4	5
4-16. Contact with the toilet door	2	4	12	4-16-1 Toilet door should be installed in such a way that it can be opened and closed easily.	1	4	5
4-17. Exposure to movement restrictions	3	4	16	4-17-1. Check if the patient has the necessary physical activity or not? 4-17-2. Be sure to consider the patient's type of surgery and the patient's movement restrictions 4-17-3 Movement aids such as canes and walkers must be placed in a suitable place in the room	2	4	12
4-18.Contact with sharp objects	2	4	12	4-18-1. Proper patient monitoring 4-18-2. Keep sharp objects away from the patient	1	4	5
4-19. Hitting by flat bars and rail guards	2	4	12	4-19-1. Use healthy and appropriate tools 4-19-2.Teaching the patient how to use equipment properly and his regular checks	1	4	5
4-20. Placing between the bed and the railings next to the bed	2	4	12	4-20.1 Training the way of working with railings next to the bed 4-20-2 Training on how to open and close the fence next to the bed	1	4	5
4-21 Being hit by objects at room height	3	4	16	4-21-1 Check equipment connections regularly	2	4	12
4-22 Contact of dangerous substances with the patient (leakage of chemotherapy serum to the patient's skin)	2	4	12	4-22-1 During medication, make sure that the connections are tightly closed	1	4	5
23-4 being hit (by companions)	2	4	12	4-23-1 In accordance with the space of the room, let the companions enter the room	1	4	5
24-4 Contact with obstacles in the health service	2	4	12	4-24-1 Remove the obstacles in the way of the patient	1	4	5

Discussion

This study was performed using an interdisciplinary approach to classify risks and possible accidents for hospitalized patients, in order to assess their level of safety through analysis of patient activities. In this study, we sought to identify and prioritize possible non-therapeutic events that may occur from the time the patient enters the hospital until the discharge. Because we believed that the use of occupational safety analysis technique can be an effective step in improving the level of safety of patients. Studies have confirmed that although to identify risks to the patient's safety in a health environment, various methods have been used, such as modes such FMEA and RCA, but health care organizations should not rely solely on those outcomes to identify patient safety risks (28-30); because methods such as RCA are retrospective and systematically examine error-related processes (31,32) However, in this study, we were to identify potential risks, in order to take steps to prevent accidents that threaten the patient's safety, because it is necessary to make every effort to improve patient safety in the hospital.

The results of the present study have shown that the

recurrence and severity of risk and, consequently, the level of risk identified in various stages of hospitalization are different. A study conducted in 2006 to investigate the report of accidents and external factors affecting the patient's fall also revealed that different factors with varying severity led to injury to the patient (33). In this regard, studies have confirmed that in order to minimize and eliminate the risks threatening the patient's safety, it is necessary to implement a comprehensive program of safety interventions and supervision of professional groups working in the hospital (34-37). Also, the present study disclosed that the greatest risks will occur for the patient, when he/she is hospitalized in the room, and various factors such as the patient's clinical condition, patient education, companions and staff, structural conditions, equipment, easy and safe access to equipment must be considered for the patient to prevent accidents.

A report released by the National Center for Patient Safety (NCPS) in 2013 to determine the main cause of accidents. It also found that inadequate involvement of medical staff and patients, lack of coordination between teams, and planning delays for unknown reasons. lack of patient tracking system is among the causes of accidents (38). Also, in a study conducted in 2014 with the aim of analyzing potential errors and the effects of the nursing care process in Iran; it was confirmed that many of the errors identified can be prevented by manpower training and proper maintenance of medical equipment. The risk management requires that the health care process be more controlled to improve the efficiency and quality of care (39). So, we can identify the detailed potential risks for the patients, both in personal and organizational aspects and take steps to control the potential risks. The present study showed that if the four risks of "Struck against", "Fall to below", "Fall same level", "Struck by" are considered by the managers and technical staff of the hospital and proper control measures are taken to prevent those dangers, more than 50% of potential risks for patients will be reduced. In other words, the level of risks will be significantly reduced, so prioritization is one of the main management tasks of a hospital, and studies have emphasized it. The prioritization of threatening factors and risks for the patient, implementation of legal standards and requirements, removal of legal barriers, organizational response to the patients' needs, and creating a patient safety culture are effective measures that managers of medical centers can take to improve patient safety (17,40,41). Assessing the risks identified for patients in the present study confirms that providing control and recommended measures and providing desirable services can reduce the level of risks significantly. In Iran a study was conducted in 2015 with the aim of root analysis of an accident that resulted in death. The study results also showed that deficit in the service delivery process causes hazards for hospitalized patients (42). Overall, the present study explains that the use of risk assessment and preventive methods with the help of multidisciplinary groups is effective in understanding a process, identifying errors that may occur and reducing potential risks. In this regard, studies have confirmed that analytical tools can provide a strong insight into the reasons for the result, because understanding the causes of errors is important and using this understanding to change the trends is critical for improvement (43-45). The results of a study conducted to analyze the error cases and their effects in a hospital in Iran in 2012 also showed that the use of risk management tools has identified and eliminated potential risks in the hospital and created a safe environment for employees and patients (46). In general, given the importance of patient safety and the need to receive safe services in the hospital to identify the roots of risks and to move toward an acceptable strategy to improve patient safety, there is a need for an interdisciplinary approach to classify potential risks for patients at different stages. In this way we may be able to classify the identified risks and make appropriate decisions to eliminate them. So, in this study, we have used the job analysis technique for the first time to assess the level of safety of hospitalized patients in Iran. It is suggested that in addition to educating staff, patients and companions in terms of structure, attention to the environment and proper space in the hospital, the use of safe and comfortable equipment should be considered by officials and managers.

In general, many research has been conducted by safety job analysis (SJA) technique in various industries (47,48), but in terms of patient safety, this technique has not been used so far, which is one of the strengths of the present study. Because we believe that this technique, along with others, as well as methods of risk assessment can identify a comprehensive list of threats to patient safety and contribute to the quality of care and patient safety. Another strength of this study is the consensus of experts in various fields, to achieve potential patients' risks. One of the limitations of this study is that due to Covid 19 disease and its potential risk for specialists, we have used a limited number of people to hold meetings.

The findings of this study showed that the frequency and severity of the risk and consequently, the level of risks identified in different stages of hospitalization are different. Therefore, by improving the level of management and prioritization and providing control and

the proposed solutions, which are among the main management tasks in a hospital, an effective step can be taken to improve the safety of patients hospitalized. It is recommended that hospital managers consider the use of occupational safety analysis technique which is newly called patient safety analysis technique as a valuable management tool to identify potential risks to hospitalized patients, so that errors can be determined prospectively and plan to prevent them.

Acknowledgments

Hereby, all the loved professors and people who helped us are appreciated

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