

RESEARCH ARTICLE

Editorial Process: Submission:00/00/0000 Acceptance:00/00/0000

Enhancing Patient Safety: Optimizing Fall Risk Management for Oncology Patients through Failure Modes and Effects Analysis

Mohamad Majed¹, Omar Ayaad^{2*}, Nabiha Said AlHasni¹, Rawan Ibrahim², Shinnona Hamed AlHarthy³, Kefah Kaid Hassan¹, Razzan Al-Zadjali², Huda Al-Awaisi¹, Khalid Al-Baimani^{2,4}

Abstract

Objective: This study aimed to enhance patient safety by optimizing fall risk management for oncology patients utilizing Failure Modes and Effects Analysis (FMEA) within outpatient settings. **Methods:** The project was conducted at the SQCCRC, focusing on outpatient clinics, daycare, radiology, radiotherapy, and rehabilitation. An observational analytical design was employed to evaluate the fall risk assessment process pre and post-interventions. A 7-step FMEA methodology was applied, involving defining the system, identifying potential failure modes, assessing their effects, assigning severity, likelihood, and detection ratings, and implementing corrective actions. Risk Priority Numbers (RPNs) were used to gauge the impact of interventions on reducing fall risk. **Results:** Following interventions, substantial reductions in RPNs were observed in various failure modes such as “Wrong assessment” (57% decrease), “Complex risk assessment scale” (63% decrease), and “Missed fall assessment” (80% decrease). Improvements were also noted in fall risk precaution measures, with reductions in RPNs for “Unclear fall precaution measures-responsibilities” (80% decrease) and “Missed bracelets for high risk” (57% decrease). In the Patient Education process, significant RPN reductions were seen for “No/improper education” (57% decrease) and “Unuse of educational material and resources” (55% decrease). Overall, there was a 62% reduction in RPNs across all failure modes in patient fall assessment and management. **Conclusion:** FMEA proves to be a valuable strategy for mitigating fall risks among oncology patients. However, success hinges on addressing identified limitations and ensuring the thorough implementation and maintenance of corrective actions.

Keywords: Risk of patient fall- oncology patients- failure modes and effects analysis- SQCCRC- Oman

Asian Pac J Cancer Prev, 25 (2), 689-697

Introduction

The term “patient falls” refers to instances where a patient unintentionally descends to the ground. These incidents can occur due to various reasons, including slips, trips, or balance issues. Locations such as residential homes, hospitals, and long-term care facilities like nursing homes are common settings where patient falls can occur. The severity of patient falls can vary from minor incidents like slipping on wet surfaces to more serious situations such as falling out of bed or from a wheelchair [1].

When a patient falls, there are typically two outcomes: either the patient experiences physical harm or remains unscathed. In some cases, patients may fall without

sustaining any injuries [2]. Factors like low-friction surfaces or loss of balance can contribute to minor falls, where medical intervention may not be necessary even if the patient appears distressed. However, falls can also result in significant injuries such as head trauma, fractures, cuts, bruises, or loss of consciousness, with varying degrees of severity and even fatal outcomes [3-5, 2].

Assessing the likelihood of a fall is crucial in preventing such incidents. Conducting a comprehensive fall risk assessment involves reviewing the patient’s medical history, conducting a thorough physical examination, evaluating the patient’s surroundings, and assessing behavioral patterns to identify individuals at higher risk of falling. Based on the assessment findings, healthcare

¹Department of Nursing, Sultan Qaboos Comprehensive Cancer Care and Research Centre (SQCCRC), Muscat, Oman. ²Quality and Accreditation Department, Sultan Qaboos Comprehensive Cancer Care and Research Centre (SQCCRC), Muscat, Oman. ³Admission, Discharge, and Transfer Office, Sultan Qaboos Comprehensive Cancer Care and Research Centre (SQCCRC), Muscat, Oman. ⁴Medical Oncology Department, Sultan Qaboos Comprehensive Cancer Care and Research Centre (SQCCRC), Muscat, Oman. *For Correspondence: omarayad86@yahoo.com

professionals can implement interventions to reduce the risk of falls, such as modifying the environment, providing assistive devices, or adjusting medication regimens [6, 7].

Cancer patients are particularly vulnerable to falls due to various factors associated with their condition and treatments. The physical weakness and fatigue commonly experienced by cancer patients can significantly impair balance and increase the likelihood of falls. Research indicates a correlation between cancer therapies, particularly chemotherapy, and side effects like fatigue and cognitive impairment, contributing to the increased fall risk [8, 9].

The impact of cancer and its treatments on mobility is also noteworthy, with some cancer medications causing issues such as sensory impairments in the lower limbs, including symptoms like paresthesia or hypoesthesia. Sensory deficits can exacerbate fall risk, especially in individuals who have difficulty sensing their lower extremities due to such impairments. Cognitive complications such as memory loss and disorientation have been observed as potential consequences of cancer and its therapies, further heightening the risk of falls [8, 10].

Cancer patients may exhibit a higher propensity for experiencing adverse effects due to their illness and treatment regimens, rendering them more susceptible to prolonged recovery from falls. Common injuries resulting from falls include traumatic brain injuries, fractures, abrasions, and contusions. Individuals diagnosed with cancer, particularly those with pre-existing conditions like osteoporosis or brittle bones arising from either the disease or its treatments, face an increased risk of sustaining wounds [3, 11].

For patients requiring hospitalization or additional medical interventions post-fall, the treatment and recovery process may be protracted, hindering engagement in physical therapy or rehabilitation efforts, especially if mobility challenges persist due to recurring falls. The emotional toll induced by falls can amplify existing fears and distress in cancer patients grappling with the multifaceted impacts of their condition and treatment, potentially impeding their ability to carry out daily activities and diminishing their overall quality of life [3, 11].

Patient falls are a prevalent concern in outpatient settings like medical offices, rehabilitation centers, and diagnostic imaging facilities, particularly among oncology patients who contend with ongoing health issues, medication regimes, and frequent follow-up appointments [8, 9].

The limitations of outpatient healthcare facilities may impede fall risk mitigation efforts, as inadequate access to technological resources and reluctance among patients to discuss fall risk could result in suboptimal participation in fall risk assessments. Incomplete or cursory fall risk evaluations may overlook crucial opportunities to implement preventive strategies, consequently increasing the likelihood of falls [1, 5, 12].

Given these challenges, healthcare providers must maintain vigilance in assessing fall risks among patients and adjust their management strategies accordingly

to enhance patient safety and well-being. Proactive monitoring of fall risk levels can effectively reduce the incidence of falls and promote patient welfare [1].

Failure Modes and Effects Analysis (FMEA) offers a systematic approach to identifying potential failure modes within a system, forecasting the repercussions of such modes, and developing measures to mitigate associated risks. In the context of healthcare facilities, FMEA emerges as a promising tool for addressing and mitigating the risks of patient falls by pinpointing potential failure modes, analyzing their impact, and implementing risk-reduction strategies. Studies by Dehnavieh et al. [13] and Haroun et al. [14] have utilized FMEA to enhance service quality and operational efficiency.

Situated in Oman, the Sultan Qaboos Comprehensive Cancer Care and Research Center (SQCCCRC) specializes in providing advanced cancer care services. This esteemed institution offers a wide array of services encompassing cancer diagnosis, treatment, and patient support, emphasizing a comprehensive approach to cancer management. Furthermore, the SQCCCRC actively engages in cutting-edge cancer research endeavors aimed at advancing treatment modalities and enhancing our understanding of cancer and its therapeutic interventions. Noteworthy services provided by the center include palliative care, surgical oncology, radiation oncology, and medical oncology.

In addition to its core treatments, the institution extends supplementary support services such as nutritional counseling, psychological assistance, and rehabilitative programs tailored to assist patients and their families in coping with the physical and emotional challenges associated with cancer. The overarching mission of the SQCCCRC is to elevate the quality of life of cancer patients in Oman while contributing significantly to the global fight against cancer through a holistic approach integrating treatment and research initiatives.

In the realm of outpatient care, an observation was made that patient falls had not exhibited a noticeable impact. However, a concerning finding emerged regarding the compliance of the outpatient setting with the risk assessment protocols, falling below the 90% threshold, signifying an elevated risk of falls for patients. This compelling revelation prompted the undertaking of the present study, which sought to mitigate the risk of patient falls among oncology patients in outpatient settings using FMEA.

Materials and Methods

Setting

This project was conducted in various outpatient settings at the SQCCCRC, encompassing outpatient clinics, daycare, radiology, radiotherapy, and rehabilitation facilities.

Design

The current study employed an observational analytical design within outpatient environments to assess the fall risk assessment process. Observational analytical designs, commonly utilized in epidemiology, social sciences, and

health sciences, aim to investigate causal relationships [15, 16].

A 7-step methodology for FMEA was implemented, as detailed in Table 1. The team meticulously scrutinized the procedure and guidelines, drawing insights from experts in quality management, nursing, admissions, and discharge processes. Numerous potential failure points were identified and evaluated during this analysis [17, 18].

The interdisciplinary team, comprising members from quality and accreditation, nursing departments, and admission, transfer, and discharge offices, oversaw the observation of the current fall assessment process in outpatient settings, executed FMEA steps, devised and implemented interventions, and assessed the outcomes using Risk Priority Numbers (RPNs).

Procedure

The initial step involved clearly delineating the system or process under examination. This clarity was achieved through the creation of process maps or flowcharts. The flowchart depicting the fall risk assessment process in outpatient settings revealed deficiencies in established protocols at reception areas concerning the systematic recording and execution of preventive measures, potentially leading to communication gaps and record-keeping lapses undermining fall management efficacy.

Identify Potential Failure Modes and Evaluate Effects

Subsequent phases involved identifying all potential failure modes within the system and evaluating their impacts comprehensively. This process entailed collaborative brainstorming with specialists, reviewing historical incidents, or conducting hazard assessments. The team classified failure modes into the following categories:

- Process failure: Problems in the design or implementation of fall prevention processes, including staffing issues, lack of standardized risk assessments, or poor communication among healthcare providers.
- Human error: Mistakes made by healthcare personnel, such as inadequate patient assessments, improper assistance during transfers, or misuse of assistive devices.
- Patient-specific factors: Factors related to the patient's medical condition or treatment, such as mobility limitations, cognitive changes, or adverse effects of medication.
- Equipment failure: Malfunctions or improper use of equipment like walkers, canes, or bedrails that are meant to assist patients [19].

Healthcare professionals can effectively understand the root causes of patient falls, design interventions to reduce fall risks, and improve patient safety by conducting a thorough root cause analysis [19].

Assign Severity, Likelihood, and Detection Ratings

The severity rating for each failure mode was determined by evaluating its impact on a scale of 1 to 10, where 1 signifies a minor impact and 10 indicates a severe consequence. This rating system provided insights into the relative impact of each failure mode on the system or

process. Assessing the likelihood of occurrence involved assigning ratings from 1 (low likelihood) to 10 (high likelihood), reflecting the probability associated with each failure mode. Additionally, the team assigned detection ratings ranging from 1 to 10, with higher values indicating better detectability, to gauge the team's ability to identify each failure mode before it manifests. Calculating the Risk Priority Number (RPN) was vital for prioritizing the failure modes [20].

Calculation of the Risk Priority Number (RPN)

The RPN calculation was conducted to prioritize the identified failure modes [20]. This analysis was carried out both before and after implementing the primary interventions.

Ethical Consideration

Institutional review board approval was obtained from the Research Office at the Sultan Qaboos Comprehensive Cancer Care and Research Centre (SQCCRC) in Muscat, Oman (Approval Number: CCCRC-57-2023).

Results

Initial Risk Priority Numbers (RPNs)

The investigation revealed several significant failure modes within the fall risk management process, each associated with initial RPNs exceeding 200, indicating elevated risk levels and criticality (Table 2). These identified failure modes spanned various elements of the process, including inaccuracies in evaluations due to insufficient staff education, highlighting the necessity for improved patient fall risk screening protocols.

Challenges in the regular monitoring of patients for fall risk stemmed from the complexity of risk assessment scales, resulting in missed opportunities for timely interventions. Additionally, ambiguities in procedural guidelines and assignment of responsibilities for fall assessment contributed to instances where assessments were overlooked, contributing to knowledge gaps and inadequate patient screening. Regarding fall risk mitigation strategies, failure modes included oversights in implementing precautions for high-risk patients, often due to deficiencies in staff education and a lack of clarity in applying preventive measures effectively. Role ambiguity and inadequate allocation hindered the successful execution of interventions aimed at fall prevention. Particularly concerning was the inadequate

Table 1. The 7-Step Process for Failure Modes and Effects Analysis (FMEA)

Step	Description
1	Define the system or process
2	Identify potential failure modes
3	Evaluate the effects of each failure mode
4	Assign a severity rating
5	Assign a likelihood of occurrence rating
6	Assign a detection rating
7	Identify and implement corrective actions

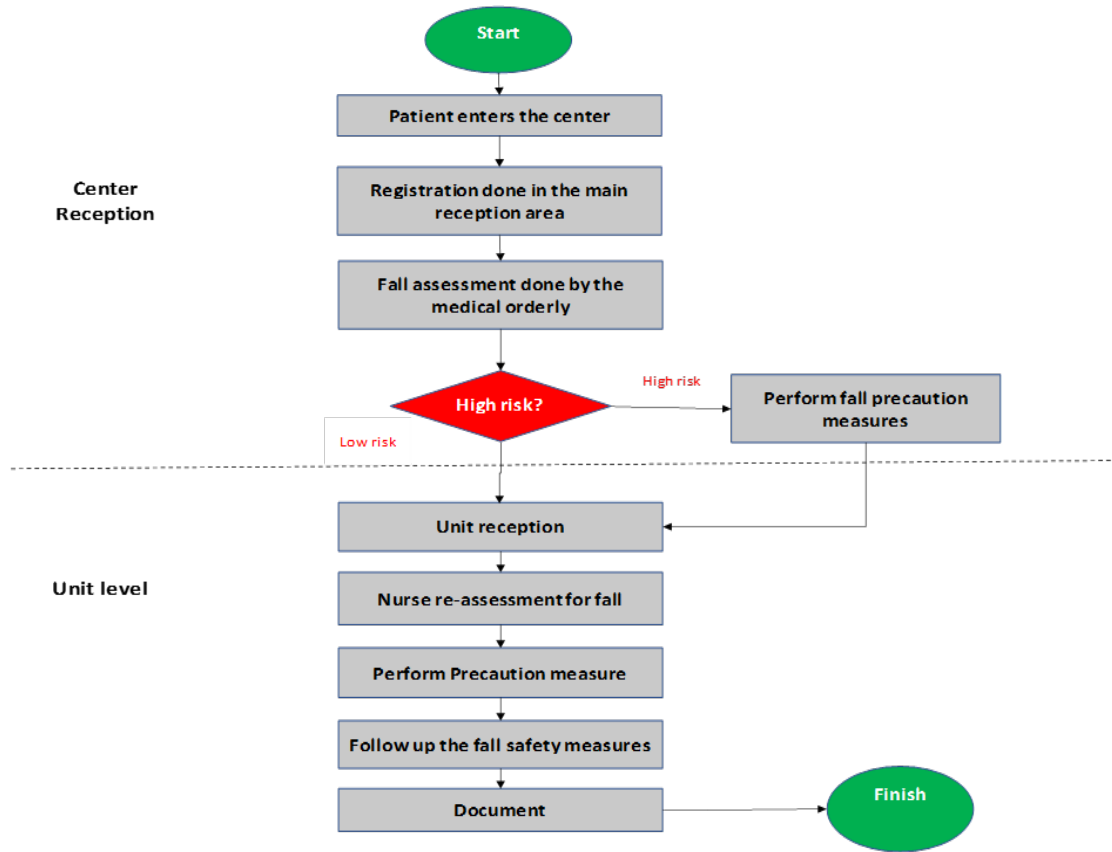


Figure 1. Pre Intervention Flow Chart for Fall Management Process

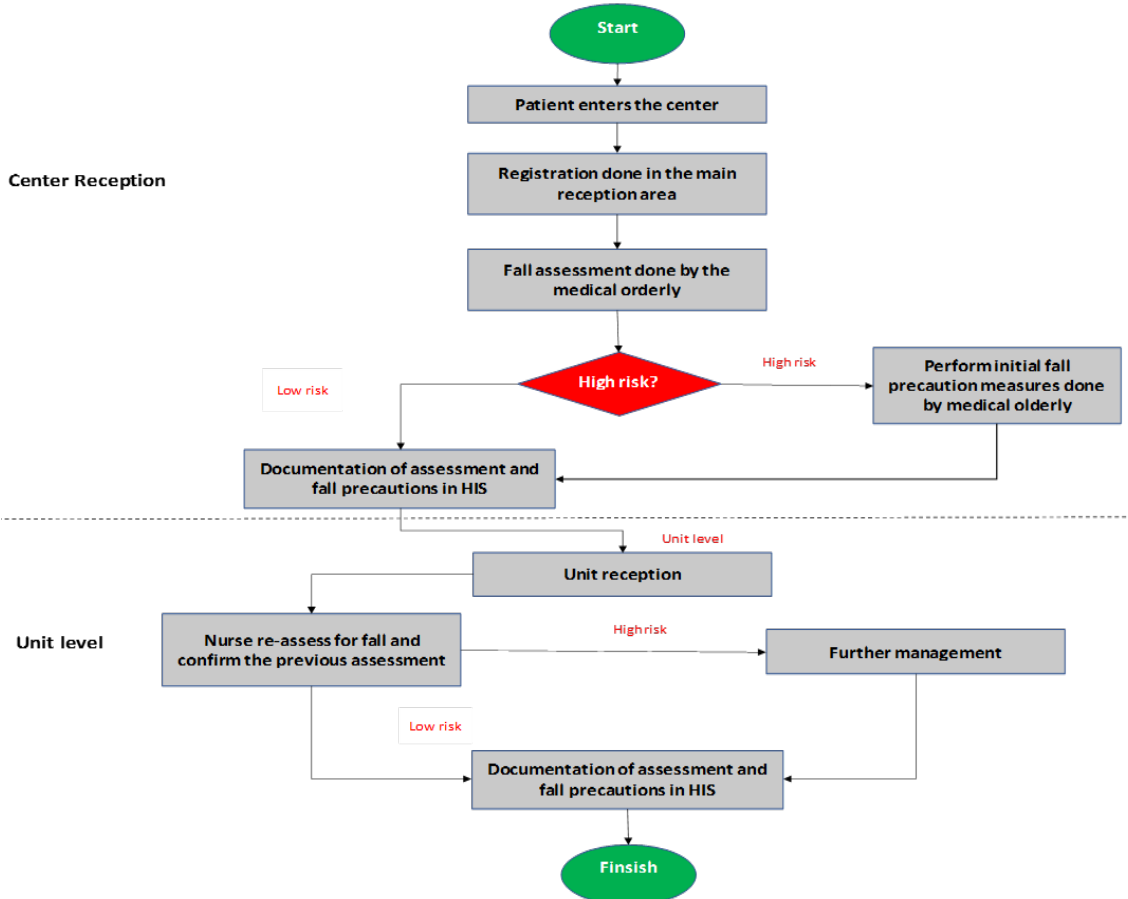


Figure 2. Post Intervention Flow Chart for Fall Management Process

Table 2. Main Failure Modes, Causes, Effects, and Pre and Post Risk Priority Numbers (RPNs) per Process

Process	Main Failure Modes	Causes	Effects	Initial RPN	Post intervention RPN	Difference (%)
Fall screening	Wrong assessment	Improper staff education	Lack of knowledge to screen the patients.	256	110	57%
		Complex risk assessment scale	Unable to assess patients periodically due to complex scale	288	105	63%
Fall screening	Missed fall assessment	Unclear process and responsibility for fall assessment	Premature process led to knowledge deficit and no proper patient screening for fall	360	72	80%
		Improper staff education	Lack of knowledge to screen the patients.	256	110	57%
		Complex risk assessment scale	Unable to assess patients periodically due to complex scale	288	105	63%
		Missed Fall risk precaution measures for high risk	Lack of knowledge to implement fall precaution measures	256	110	57%
Fall risk precaution measures	Missed Fall risk precaution measures for high risk	Unclear fall precaution measures-responsibilities	No proper distribution of responsibilities	360	72	80%
		Missed bracelets for high risk	Absence of implementing precaution measurement for fall	256	110	57%
		Improper staff education	Lack of knowledge to implement fall precaution measures	256	110	57%
Fall risk precaution measures	Insufficient measures	Lack of proper distribution and available equipment	Unable to implement fall precaution measures	192	110	43%
		No clear process (responsibilities)	No proper distribution of responsibilities	360	110	69%
Fall risk precaution measures	Un-documented intervention	Unaware of the documentation requirement	Lack of fall precaution measures documentation	192	110	43%
		Improper staff education	Lack of patient awareness	256	110	57%
Patient Education	No/improper education	Unuse of educational material and resources	Absence of patient education	243	110	55%

*RPN, Total Risk Priority Numbers

implementation of preventive measures, such as the utilization of high-risk fall bracelets, further compromising fall prevention efforts.

A recurring concern throughout the study was the lack of comprehensive documentation regarding interventions, reflecting uncertainties surrounding processes and responsibilities for documentation. This deficiency in documentation could impact the quality of patient care and impede the assessment of the effectiveness of fall risk mitigation measures. The identified high-RPN failure modes underline the urgent need for measures to enhance patient safety and mitigate adverse outcomes. Addressing these deficiencies is crucial for optimizing fall prevention strategies and elevating healthcare standards. Implementing tailored interventions focusing on key areas can bolster care excellence and safeguard patients from fall-related incidents.

Identify and Implement Corrective Actions

This phase of the process entails pinpointing and executing remedial actions to reduce risks associated with each failure mode, considering factors like severity, likelihood of occurrence, and detection ratings. Multiple interventions were carried out to alleviate fall risks tied to high RPN failure modes. These evidence-based interventions, detailed in Table 3, encompassed

Scale Modification (Figure 1)[6] [21, 22], Process and Responsibility Modifications (Figure 2) [23-25], Resource and Information Technology Utilization [26-28], Policy Updates, and Staff Education and Training [23, 21].

Post-Intervention Risk Priority Numbers (RPNs)

Table 1 presents the primary failure modes, their causes and effects, and the baseline and RPNs depicted as percentage differences for each process. The study aimed to evaluate the effectiveness of interventions in addressing identified failure modes related to patient fall risk management. The findings revealed a substantial 62% reduction in total RPNs across all failure modes.

In the fall screening process, the “Wrong Assessment” failure mode saw a significant 57% decrease in RPN post-intervention, addressing deficiencies in staff education that had previously led to inaccuracies in patient screening. Similarly, the “Complex Risk Assessment Scale” failure mode showed marked improvement, with a notable 63% reduction in RPN after resolving issues related to the complexity of the assessment scale, facilitating more streamlined patient evaluations.

Another prominent failure mode, “Missed Fall Assessment,” experienced a noteworthy 80% decrease in RPN following intervention implementation. This reduction can be attributed to rectifying unclear processes

Table 3. Main Interventions for High-Risk Failure Modes in Fall assessment Screening Process

Main Interventions	Description
Scale Modification	A new scale, the Morse fall scale, has been introduced specifically for the outpatient setting. This scale comprises four questions that will be asked by medical orderlies and receptionists during the patient screening process. The questions are as following: (1)Do you have dizziness or vertigo?, (2)Do you use ambulatory aids(walker, crutch, artificial limbs)?, (3) Have you fallen within the last 6 months?, (4) Do you have any visual problem?. The Morse scale is designed to assess the patient's risk of falling and helps identify high-risk individuals. By utilizing this scale, healthcare providers can better tailor fall prevention strategies to each patient's needs and potential risks.
Process and Responsibility Modifications	The Morse fall scale's implementation includes specific responsibilities for medical orderlies and receptionists during the patient screening process. They are required to ask the four questions included in the scale to assess fall risk accurately. Additionally, if a patient is identified as high risk, precautions for fall prevention will be promptly initiated. These precautions will be well-documented in the health informatics system, ensuring that the entire healthcare team is aware of the necessary interventions. Patient education regarding fall precautions will also be a part of this process, ensuring patients understand the importance of adhering to the safety measures in place. The same responsibility were adopted also at unit level by the health provider.
Resource and Information Technology Utilization	To support the efficient implementation of the fall prevention program, the admission discharge transfer team has been provided with access to the Morse fall scale and relevant interventions. This access allows them to promptly document the patient's fall risk, enabling timely initiation of fall precautions. Additionally, an electronic tracking system has been implemented at the center's entrance. This system effectively monitors and traces all patients' fall risks upon registration, providing real-time information to the healthcare team. The utilization of resources and information technology enhances the overall fall management process by streamlining data collection and ensuring timely intervention.
Policy Update	A comprehensive policy update on Fall Prevention and Management has been adopted. The policy includes the incorporation of the new Morse fall scale and its associated interventions into the standard practice. Furthermore, the policy revision includes the addition of any necessary changes to improve fall prevention protocols. This updated policy serves as a guiding framework for healthcare providers, ensuring standardized and evidence-based fall management across the entire healthcare facility. It also emphasizes the importance of continuous improvement and adherence to best practices in fall prevention.
Staff Education and Training	Staff education and training programs have been initiated to enhance the knowledge and skills of healthcare professionals regarding fall prevention and management. These programs aim to familiarize staff members with the Morse fall scale, assessment techniques, and intervention strategies. Additionally, the training emphasizes the importance of patient education on fall precautions and safety measures. By investing in staff education and training, healthcare providers can ensure that all team members are well-equipped to provide optimal care and minimize fall risks for patients.

References: (6, 22, 24, 26).

and responsibilities, which had previously impeded the execution of the assessment process and information gathering. Additionally, interventions led to a 57% reduction in RPN for “Improper Staff Education” and a 63% reduction for “Complex Risk Assessment Scale,” indicating improvements across these critical areas post-implementation.

Analysis of Fall Risk Precaution Measures

In the domain of fall risk precaution measures, significant improvements were noted in various failure modes post-implementation of interventions.

- The failure mode “Missed Fall Risk Precaution Measures for High-Risk” displayed a substantial 57% decrease in RPN following interventions, showcasing their efficacy in addressing staff education concerns.

- Interventions targeting the issue of “Unclear Fall Precaution Measures-Responsibilities” resulted in an impressive 80% reduction in RPN, effectively mitigating risks stemming from inadequate responsibilities allocation.

- Mitigation efforts for the “Missed Bracelets for High Risk” failure mode led to a notable 57% decrease in RPN, enhancing the effectiveness of fall prevention protocols

for high-risk patients.

Mitigation of Fall Risk Factors

In the realm of fall risk mitigation, interventions aimed at rectifying the “Insufficient Measures” failure mode led to a significant 57% decrease in RPN. This reduction was primarily attributed to thorough staff education, enabling the proficient implementation of preventive measures.

Furthermore, addressing the deficiency in equipment distribution and availability resulted in a noteworthy 43% decrease in RPN, facilitating the successful implementation of fall precautionary measures.

Improving Fall Risk Preventive Measures

- The “Undocumented Intervention” failure mode within the fall risk preventive measures process exhibited a substantial 69% decrease in RPN post-intervention, effectively resolving ambiguities in processes and responsibilities.

- Similarly, tackling the failure mode related to a lack of awareness of documentation requirements led to a significant 43% decrease in RPN, achieved through procedural enhancements to ensure comprehensive

documentation of fall precautionary measures.

Enhancing Patient Education

In the realm of patient education, interventions focusing on augmenting staff education and patient awareness yielded notable reductions in RPN for the “No/Improper Education” and “Underutilization of Educational Material and Resources” failure modes. Specifically, reductions of 57% and 55% were observed, indicating the effectiveness of interventions in addressing identified issues and enhancing the patient education process.

Discussion

The study conducted a proactive risk assessment within a specialized cancer facility in Muscat, Oman, utilizing FMEA approach to evaluate and enhance fall risk assessments in outpatient settings. The primary goal was to reduce the risk of patient falls among oncology patients in outpatient care, drawing on existing research that had explored diverse interventions for fall mitigation in outpatient environments [15, 14, 18, 29].

The implementation of the FMEA approach, supported by an observational analytical design, yielded a substantial 62% reduction in patient fall risks, showcasing the effectiveness of this proactive strategy in mitigating potential fall hazards. Traditionally, initiatives addressing patient falls often adopt a reactive stance, responding after an adverse event occurs. In contrast, this study took a proactive stance by employing the FMEA methodology to preemptively identify weaknesses in the fall assessment process within outpatient settings, uncover root causes, and predict resultant effects [15, 14, 18, 29]. By proactively utilizing the FMEA methodology, this project aimed to flag potential issues in fall risk assessments before they actualize and proactively mitigate associated risks. The proactive approach in healthcare settings, such as that employed in this study, holds promise in averting negative consequences linked to patient falls [17].

Patient falls in outpatient settings are often linked to human error, where lapses in fall risk evaluations or management by healthcare personnel can lead to adverse events. Inadequate fall risk assessments may stem from incomplete evaluations by healthcare providers or the omission of validated assessment tools, emphasizing the need for comprehensive fall risk screenings [15, 14, 18, 29]. Furthermore, noncompliance with established protocols and miscommunications among healthcare teams can contribute to misconceptions or ineffective management of fall risk, underscoring the importance of clear communication and adherence to standardized protocols in mitigating patient fall risks [15, 14, 18, 29].

The reduction of human error in healthcare settings can be attained through comprehensive training for healthcare providers, the establishment of clear protocols and guidelines for fall assessment and management, and fostering improved communication and collaboration among healthcare professionals. By addressing human error, healthcare practitioners can effectively minimize the risk of patient falls in outpatient settings [14, 18, 29].

Process failures have been identified as influential factors in patient falls within outpatient settings. These failures can arise during the fall assessment process when systems or procedures for evaluating and managing fall risk need enhancement for efficiency. Lack of standardization can lead to inconsistent approaches to fall assessment and management among healthcare professionals, potentially impacting the quality of care [3-5, 2].

Inadequate communication can contribute to gaps among healthcare professionals or between providers and patients, leading to misunderstandings and suboptimal fall risk management [30]. Equipment failures can also play a role in patient falls in outpatient settings. Malfunctioning or improper use of patient-assisting devices like walkers, canes, or bedrails can trigger equipment-related incidents during the evaluation process [3-5, 2].

Implementing regular equipment maintenance and inspection routines, integrating safety considerations into equipment design, and providing thorough training programs can help mitigate equipment-related failures in fall assessments. Healthcare providers can address equipment failures by incorporating device reliability into the fall risk assessment protocol [3-5, 2].

While FMEA approach has proven effective in reducing errors in fall risk assessment, it is essential to recognize its limitations. Successful implementation of the fall risk assessment process requires a specialized team with the expertise to analyze and understand the complexities of the procedure effectively. Collaboration and expertise play key roles in the effectiveness of the FMEA approach. While the implementation of FMEA approach can be challenging and resource-intensive, its effectiveness in risk mitigation is well recognized. However, it is important to note that FMEA does not guarantee complete error elimination [13, 14].

FMEA offers a systematic framework for identifying hazards and devising appropriate remedial measures. The success of these measures heavily depends on the meticulous development and execution of a coherent action plan. Active engagement of frontline staff is crucial for successful implementation, as any resistance to change may impede the intended fall hazard mitigation. Ensuring the standardization of fall risk assessment protocols is vital, yet achieving consistent compliance across diverse staff members and departments poses a challenge that can impact the overall efficacy of the process [13, 14].

In conclusion, FMEA serves as a proactive risk assessment tool characterized by its continuous and iterative nature. Sustained commitment and allocation of resources are essential to uphold the momentum required for ongoing monitoring and improvement. The adoption of FMEA proves beneficial in mitigating fall hazards among cancer patients. However, addressing constraints and diligently implementing and maintaining corrective measures are critical for maximizing its effectiveness.

Author Contribution Statement

Khalid Al Baimani and Omar Ayaad: supervision of the whole steps of project; Mohammad Majed, Nabiha

Said AlHasni, Shinnona Hamed AlHarthy. Kefah Kaid Hassan, Huda Al-Awaisi: Implementing the FMEA approach and interventions; Omar Ayaad, Rawan Ibrahim, Huda Al-Awaisi, Razan Al Zadjali: Preparing and review manuscripts

Acknowledgements

The authors extend their gratitude to the leadership team, nursing staff, cybersecurity and informatics personnel, admission, discharge, and transfer staff, and the research office at the Sultan Qaboos Comprehensive Cancer Care and Research Centre for their invaluable support throughout this study.

Funding Statement

No fund was received to conduct this research.

Scientific Approval

The proposal of the study was reviewed and approved by the research office in Sultan Qaboos Comprehensive Cancer Care and Research Centre (SQCCRC), Muscat, Oman

Ethical Declaration

The Institutional Review Board (IRB) approval to conduct the study was taken from the research office in Sultan Qaboos Comprehensive Cancer Care and Research Centre (SQCCRC), Muscat, Oman (CCRC-57-2023).

Data Availability

Data is available upon request.

Conflict of Interest

The authors have no conflicts of interest to disclose.

References

1. Ha VT, Nguyen TN, Nguyen TX, Nguyen HTT, Nguyen TTH, Nguyen AT, et al. Prevalence and factors associated with falls among older outpatients. *Int J Environ Res Public Health*. 2021;18(8). <https://doi.org/10.3390/ijerph18084041>.
2. Oliver D, Daly F, Martin FC, McMurdo ME. Risk factors and risk assessment tools for falls in hospital in-patients: A systematic review. *Age Ageing*. 2004;33(2):122-30. <https://doi.org/10.1093/ageing/afh017>.
3. Christiansen TL, Lipsitz S, Scanlan M, Yu SP, Lindros ME, Leung WY, et al. Patient activation related to fall prevention: A multisite study. *Jt Comm J Qual Patient Saf*. 2020;46(3):129-35. <https://doi.org/10.1016/j.jcjq.2019.11.010>.
4. Fulton JJ, LeBlanc TW, Cutson TM, Porter Starr KN, Kamal A, Ramos K, et al. Integrated outpatient palliative care for patients with advanced cancer: A systematic review and meta-analysis. *Palliat Med*. 2019;33(2):123-34. <https://doi.org/10.1177/0269216318812633>.
5. Mehta J, Knowles K, Wilson E. Prevalence of falls in patients presenting to an ophthalmic outpatients department- a surveillance study. *Br Ir Orthopt J*. 2021;17(1):134-41. <https://doi.org/10.22599/bioj.178>.
6. Agency for Healthcare Research and Quality. Tool 3H: Morse Fall Scale for Identifying Fall Risk Factors. Agency for Healthcare Research and Quality. 2013.

7. Yamamoto S, Fujikawa N, Asano K, Toki M, Takao A, Arao H. Assessment of fall-related self-efficacy: Characteristics that influence the perception of patients with chemotherapy-induced peripheral neuropathy. *Asia Pac J Oncol Nurs*. 2020;7(2):190-5. https://doi.org/10.4103/apjon.apjon_54_19.
8. Abdelbasset WK, Nambi G, Elsayed SH, Osailan AM, Eid MM. Falls and potential therapeutic interventions among elderly and older adult patients with cancer: A systematic review. *Afr Health Sci*. 2021;21(4):1776-83. <https://doi.org/10.4314/ahs.v21i4.34>.
9. Sattar S, Haase K, Kuster S, Puts M, Spoelstra S, Bradley C, et al. Falls in older adults with cancer: An updated systematic review of prevalence, injurious falls, and impact on cancer treatment. *Support Care Cancer*. 2021;29(1):21-33. <https://doi.org/10.1007/s00520-020-05619-2>.
10. Sattar S, Haase KR, Milisen K, Campbell D, Kim SJ, Chalchal H, et al. Oncology clinic nurses' attitudes and perceptions regarding implementation of routine fall assessment and fall risk screening: A survey study. *Can Oncol Nurs J*. 2021;31(4):367-75. <https://doi.org/10.5737/23688076314367375>.
11. Smebye KL, Granum S, Wyller TB, Mellingsæter M. Medical findings in an interdisciplinary geriatric outpatient clinic specialising in falls. *Tidsskr Nor Laegeforen*. 2014;134(7):705-9. <https://doi.org/10.4045/tidsskr.13.1287>.
12. Yulistiani Y, Utomo F, Wibisono C, Izzati Y. Analysis of fall risk increasing drugs on morse fall scale in geriatric patients (a study at geriatric outpatient clinic airangga university teaching hospital). *Pharmacia*. 2023;70:263-74. <https://doi.org/10.3897/pharmacia.70.e101609>.
13. Dehnavieh R, Ebrahimipour H, Molavi-Taleghani Y, Vafae-Najar A, Noori Hekmat S, Esmailzdeh H. Proactive risk assessment of blood transfusion process, in pediatric emergency, using the health care failure mode and effects analysis (hfmea). *Glob J Health Sci*. 2014;7(1):322-31. <https://doi.org/10.5539/gjhs.v7n1p322>.
14. Haroun A, Al-Ruzzieh MA, Hussien N, Masa'ad A, Hassoneh R, Abu Alrub G, et al. Using failure mode and effects analysis in improving nursing blood sampling at an international specialized cancer center. *Asian Pac J Cancer Prev*. 2021;22(4):1247-54. <https://doi.org/10.31557/apjcp.2021.22.4.1247>.
15. Filz M-A, Langner J, Herrmann C, Thiede S. Data-driven failure mode and effect analysis (fmea) to enhance maintenance planning. *Computers in Industry*. 2021;129:103451. <https://doi.org/10.1016/j.compind.2021.103451>.
16. Type of Research and Type Research Design. In: *Social Research Methodology*. 2020.
17. Institute for Healthcare Improvement (2020b). Failure Modes and Effects Analysis (FMEA) Tool. Opelika, Alabama, USA: East Alabama Medical Center; 2020.
18. Jain K. Use of failure mode effect analysis (fmea) to improve medication management process. *Int J Health Care Qual Assur*. 2017;30(2):175-86. <https://doi.org/10.1108/ijhcqa-09-2015-0113>.
19. Thomas MV. Understanding and responding to adverse events. *N Engl J Med*. 2003;348(25):2580. <https://doi.org/10.1056/nejm200306193482520>.
20. Institute for Healthcare Improvement (2020a). Failure Modes and Effects Analysis (FMEA) Scoring System. St. Louis, Missouri, USA: Missouri Baptist Medical Center; 2020
21. Al-Ruzzieh M, Rifai A, Ayaad O. Organisational citizenship behaviour in the healthcare workplace: A scoping review. *Br J Health care Manag*. 2022;28:1-7. <https://doi.org/10.12968/bjhc.2021.0039>.
22. Huang X, Yan J, Yang T, Yi Q, Shen Z, Yang G. Cost-

- effectiveness of morse fall scale assessment in fall prevention care in hospitalized patients. *Zhong Nan Da Xue Xue Bao Yi Xue Ban*. 2021;46(5):529-35. <https://doi.org/10.11817/j.issn.1672-7347.2021.200332>.
23. Al-Ruzziéh MA, Eddin R, Ayaad O, Kharabsheh M, Al-Abdallah D. Examining nurse and patient factors before and after implementing an oncology acuity tool: A mixed methods study. *J Nurs Meas*. 2023. <https://doi.org/10.1891/jnm-2022-0001>.
 24. Ayaad O, Al-Dewiri R, Kasht L, Qaddumi B, Ayyad M. Adopting lean management in quality of services, cost containment, and time management. *Asian Pac J Cancer Prev*. 2022;23(8):2835-42. <https://doi.org/10.31557/apjcp.2022.23.8.2835>.
 25. Haroun A, Ayaad O, Al-Ruzziéh M, Ayyad M. The role of total quality management in improving patient experiences and outcomes. *Br J Health care Manag*. 2022;28:1-8. <https://doi.org/10.12968/bjhc.2021.0082>.
 26. Al-Bream F, Maraqa M. The impact of adopting e-collaboration tools on knowledge management processes. *Manag Sci Lett*. 2019;9:1009-28. <https://doi.org/10.5267/j.msl.2019.4.004>.
 27. Al-Ruzziéh MA, Ayaad O, Qaddumi B. The role of e-health in improving control and management of covid 19 outbreak: Current perspectives. *Int J Adolesc Med Health*. 2020;34(4):139-45. <https://doi.org/10.1515/ijamh-2020-0072>.
 28. Sharikh E, Shannak R, Suifan T, Ayaad O. The impact of electronic medical records' functions on the quality of health services. *Br J Health care Manag*. 2020;26:1-13. <https://doi.org/10.12968/bjhc.2019.0056>.
 29. Kim C, Lee M. A study on failure mode and effect analysis (fmea) for preoperative risk prevention. *Journal of Korean Academy of Nursing Administration*. 2016;22:415. <https://doi.org/10.11111/jkana.2016.22.5.415>.
 30. Ayaad O, Haroun A, Yaseen R, Thiab F, Al-Rawashdeh K, Mohammad I, et al. Improving nurses' hand-off process on oncology setting using lean management principles. *Asian Pac J Cancer Prev*. 2019;20(5):1563-70. <https://doi.org/10.31557/apjcp.2019.20.5.1563>.



This work is licensed under a Creative Commons Attribution-Non Commercial 4.0 International License.