DOI: https://doi.org/10.54393/pjhs.v5i12.2297

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (P): 2790-9352, (E): 2790-9344
Volume 5, Issue 12 (Deccember 2024)

Original Article

OPEN ACCESS

Knowledge and Practices of Oncology and Bone Marrow Transplant Nurses in the Management of Neutropenic Fever in Patients Undergoing Chemotherapy

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ARTICLE INFO

Keywords:

Chemotherapy, Febrile Neutropenia, Infection Prevention, Bone Marrow Transplant

How to Cite:

Mir, S., Khan, M. A., Khan, F., & Butt, S. (2024). Knowledge and Practices of Oncology and Bone Marrow Transplant Nurses in the Management of Neutropenic Fever in Patients Undergoing Chemotherapy: Oncology and Bone Marrow Transplant Nurses in the Neutropenic Fever Under Chemotherapy. Pakistan Journal of Health Sciences, 5(12), 254–259. https://doi.org/10.54393/pjhs.v5i12.2297

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Received date: 20th September, 2024
Accepted date: 11th December, 2024
Published date: 31st December, 2024

ABSTRACT

Febrile neutropenia is a significant complication from chemotherapy, often being the initial indication of infection in cancer patients. Neutropenic fever requires efficient management. **Objectives:** To determine knowledge and infection control practices of Oncology and Bone Marrow Transplant Nurses in managing Neutropenic Fever in Chemotherapy patients. **Methods:** A cross-sectional survey was conducted from April to June 2024 to assess nurses' knowledge and infection control practices regarding neutropenic fever. A sample of 105 oncology and bone marrow transplant nurses was recruited from four tertiary care hospitals in Rawalpindi and Islamabad. Convenient Sampling was employed for enrolling participants. The data were collected using a structured questionnaire comprising three sections: demographic information, a 30-item true/false neutropenia knowledge questionnaire, and a 16-item practice-based questionnaire developed. Data were analyzed using SPSS version 26.0. Results were presented as frequencies and percentages, and associations were tested using the chi-square test. **Results:** The study revealed a significant correlation between knowledge scores and infection control practices. Nurses had an average knowledge score of 23.04 ± 4.0, with 50.5% demonstrating good knowledge. Infection control adherence averaged 11.91 ± 2.37, with 44.8% showing good practices. The correlation was significant (Pearson Chi-Square=20.975, p<0.001). **Conclusions:** It was concluded that nurses showed a solid understanding of neutropenia and generally followed infection control procedures, though improvements in efficacy and consistency are needed. Targeted training, ongoing education, and regular workshops can reinforce knowledge and promote best practices among nursing staff, ultimately enhancing infection control measures and improving patient outcomes.

INTRODUCTION

Neutropenia is a common side effect of chemotherapy that compromises immune function and heightens infection risk among patients. Febrile neutropenia (FN) is a serious complication of chemotherapy treatment and may present as the only clinical sign of infection [1]. Patients with febrile neutropenia are more susceptible to life-threatening bacterial infections due to a lack of inflammatory response [2]. Effective management of neutropenic fever is essential for reducing serious infections and improving patient outcomes, especially given that cancer is the second leading cause of mortality worldwide [3]. Oncology-trained nurses play a critical role in diagnosing and managing neutropenic fever, necessitating a thorough understanding of the condition and its treatment [4]. Neutropenia is a major dose-limiting adverse effect associated with chemotherapy, radiation therapy, and various blood disorders. It markedly heightens the risk of infections, which can quickly worsen and result in sepsis, a potentially life-threatening condition if not addressed swiftly. In the management of FN, Nurses are essential in managing infections related to neutropenia by enforcing preventive strategies, educating patients and their caregivers about the signs of infection, and facilitating timely medical intervention when needed '. According to a

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study conducted in (2016), nurses are vital members of multidisciplinary teams and advocates for supportive patient care. Oncology nurses bridge the gap between oncologists and patients, positively influencing outcomes by educating patients on side effects and available therapies. They also relay patients' concerns to physicians and can enhance care quality by participating in continuous improvement initiatives and developing neutropenia management guidelines [6]. Despite advancements in cancer therapies, the fundamental principles for managing neutropenia have remained largely unchanged. As front-line healthcare providers, nurses are often the first to detect serious side effects, underscoring the need for continuous education to ensure adherence to evidence-based practices [7]. However, recent research reveals significant gaps in nursing practices and knowledge regarding infection control for neutropenic patients. Ayele *et al.*, found that 75% of nurses practiced infection prevention inconsistently, with only 60% demonstrating adequate awareness of protocols. This inconsistency highlights the urgent need for standardized infection control practices, as variations in care can lead to increased patient risk [8]. It is essential to ensure the proper handling, administration, and disposal of chemotherapy drugs (CDs) to safeguard patients and healthcare personnel from potential risks. Sargidy *et al.*, aimed to assess the knowledge of oncology nurses in Sudan regarding these practices [9]. A 2021 study indicated that Lebanese nurses had a moderate understanding of neutropenia but struggled to apply this knowledge effectively, revealing deficiencies in training and a lack of comprehensive, standardized protocols for managing these patients [10]. Further complicating care, a study in Iran found discrepancies between nurses' understanding and their actual practices in infection control [11]. Research in Pakistan similarly indicated that while nurses had moderate knowledge of infection prevention, their adherence to infection control procedures was high, emphasizing the need for standardized training to bridge the gap between knowledge and practice [12]. A study by Eskander *et al.*, revealed that fewer than 75% of participants demonstrated inadequate knowledge regarding infection prevention and control measures. [13]. Sadly, numerous research revealed a significant knowledge-practice gap concerning infection prevention procedures [14]. A thorough review of the literature indicated that there is little research on nurses' understanding of CIN and how it relates to patient care in Pakistan. Nursing administrators, nurses, clinical educators, and nursing scholars could all benefit from this kind of research. The results may serve as a starting point for developing policies and putting nursing education programs into action.

This study aims to evaluate the state of nurse preparedness and implement targeted interventions to enhance standardized practices in managing neutropenic fever. The outcomes could lead to improved educational programs and updated clinical protocols, ensuring consistent and effective care for patients undergoing chemotherapy and bone marrow transplants, ultimately reducing complications and improving prognoses.

METHODS

A quantitative cross-sectional study was used to assess the knowledge and practices of oncology and bone marrow transplant nurses in the management of neutropenic fever patients from April 2024 to June 2024. There are 210 nurses in the oncology and bone marrow transplant (BMT) setting in twin cities. Cochran formula is used to calculate sample size by taking the margin of error (e) 0.07, an estimated proportion of the population (p) 0.5, a population of 2100, and a Z(a/2) score from the Z table at 95% confidence interval which was 1.96. The final sample size, based on limited population was calculated to be 105 participants. All registered nurses who were currently practicing in oncology and bone marrow transplant (BMT) units were included in the study. Whereas nurses who were unavailable during the data collection period, were approached the next day and no one was excluded. The data collection tool for this study consists of three sections. The first section covered the demographic information of the participants, and the second part was the neutropenia knowledge questionnaire, which was used for the evaluation of the knowledge of nurses regarding the disease and the care of the patients suffering from neutropenia [15]. The set of questionnaires consisted of 30 true and false statements, and each correct answer was given a score of 1; otherwise, 0. The third section was related to the prevention practices of neutropenic fever. This tool was adapted from a previous study that was conducted in Lahore, Pakistan [12]. This section of the tool was made based on the site observation done by the researcher and includes 16 practice-based questions related to the prevention of the captioned infection with "Yes" and "No" as response options. The development of this section was done as per WHO/Centers for Disease Control (CDC) guidelines, and related items of literature were checked. Scoring was done by giving '1' points for 'Yes' and 0 for 'No'. The instrument was previously validated and used in multiple international and national studies, the reliability was checked by pilot testing and the calculated Cronbach alpha was 0.805, indicating good internal consistency. The scoring system was chosen based on Bloom's taxonomy to categorize knowledge and practice levels as follows; Poor knowledge: score <60% (<18 correct answers)(indicated an insufficient understanding of neutropenia and its management). Moderate knowledge: score 61-79% (18 to

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23) (indicated a basic understanding but lacking in depth and application). Good knowledge: score 80-100% (24 to 30) (indicated comprehensive understanding and ability to apply knowledge effectively). Poor Practices: score<60% (less than 10 out of 16 scores indicated poor practices). Moderate Practice: score 61-79% (10 to 13 score indicated moderate practices). Good Practices: score 80-100% (Score 13 to 16 indicated good practices). Ethical approval was obtained from the relevant institutional review board committee (Reference No: 412-AAA-ERC-AFPGMI), and the hospital site ensuring the protection of participants' rights and welfare. Informed consent has been obtained, confidentiality and anonymity have also been carried out and voluntary participation was focused on the research process. The entire data collection process was completed, entered and coded in SPSS version 26.0 for data analysis. Descriptive statistics were applied to calculate the frequency and percentages of questionnaire items, whereas the chi-square test was used to identify the association between variables.

RESULTS

The demographic analysis of 105 oncology and bone marrow transplant nurses reveals a predominantly experienced and well-educated workforce, with 47.6% aged 31–40 years and 89.5% being female. Most participants (57.1%) held a bachelor's degree, while 35.6% had over 15 years of nursing experience. However, training in chemotherapy preparation varied, with 30.5% receiving training only once and an equal percentage having no training, indicating potential gaps in professional development. Despite a strong awareness of antimicrobial policies (83.8%) and chemotherapeutic spill kits (96.2%), the presence of a minority lacking knowledge underscores the need for continuous education. Overall, while the nurses demonstrate significant knowledge and experience, standardized training and reinforcement of key policies are essential to enhance patient care and safety in oncology settings (Table 1).

Table 1: Descriptive Characteristics of Demographic Information of Oncology and BMT Nurses

Variable	Categories	Frequency (%)
Age	20 – 30 Years	18 (17.1%)
	31 -40 Years	50 (47.6%)
	41 -50 Years	32 (47.1%)
	Above 50 Years	5 (4.8%)
Gender	Male	11 (10.5%)
	Female	94 (89.5%)
Educational Level	Diploma	40 (38.1%)
	Bachelor Degree	60 (57.1%)
	Master Degree	05 (4.8%)
Experience	1 – 5 Years	16 (15.2%)
	6 -10 Years	17 (16.2%)
	11 – 15 Years	34 (32.7%)
	More Than 15 Years	37 (35.6%)
Experience in Chemotherapy Administration	6 Months – 11 Months	17 (16.2%)
	1 Year – 3 Years	36 (34.3%)
	4 Years – 7 Years	19 (18.1%)
	Above 7 Years	33 (31.4%)
Training for Chemotherapy Preparation	Once	32 (30.5%)
	Twice	18 (17.1%)
	More Than Twice	23 (21.9%)
	Never	32 (30.5%)
Awareness of Antimicrobial Policy and Barrier Nursing	Yes	88 (83.8%)
	No	17 (16.2%)
Awareness of Chemotherapy Spill Kit	Yes	101 (96.2%)
	No	04 (3.8%)

Despite significant individual differences, nurses showed a strong awareness of neutropenia, with an average knowledge score of 23.04 ± 4.0. The true average knowledge level most likely fell within this range, as the mean score's 95% confidence interval ranged between 22.25 and 23.82. Nurses usually adhered to infection control policies well, as seen by their average score of 11.91 ± 2.37 for these techniques. The confidence interval for this score, which ranged from 11.46 to 12.37, showed an average level of adherence to infection control protocols. 50.5% of surveyed nurses demonstrated good knowledge, while 36.2% had moderate knowledge, indicating acceptable understanding. The smallest group, at 13.3%, displayed inadequate knowledge, highlighting a limited comprehension of the issue among some staff (Figure 1).

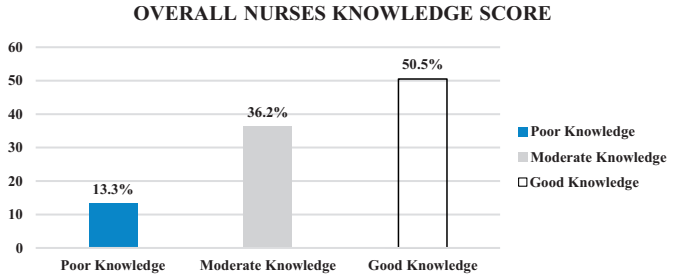

Figure 1: Overall Nurse's Knowledge Score among Study Participants

44.8% of nurses employed effective infection control practices for neutropenic patients, indicating adherence to appropriate protocols. Meanwhile, 36.2% demonstrated moderate practices, suggesting some good policies but scope for improvement. Conversely, 19.0% exhibited inadequate processes, highlighting a need for enhanced safety measures among a significant portion of staff (Figure 2).

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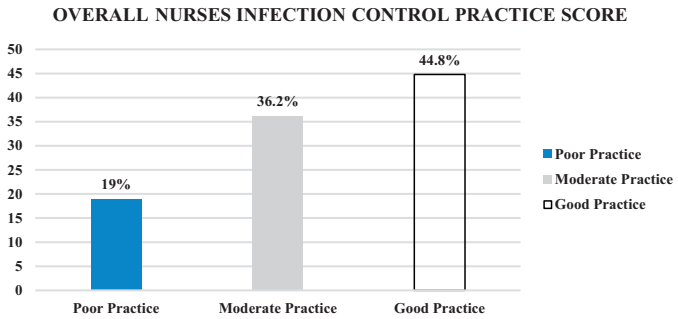

Figure 2: Overall Nurse's Infection Control Practice Score among Study Participants

Despite significant individual differences, nurses showed a strong awareness of neutropenia, with an average knowledge score of 23.04 ± 4.0. The true average knowledge level most likely fell within this range, as the mean score's 95% confidence interval ranged between 22.25 and 23.82. Nurses usually adhered to infection control policies well, as seen by their average score of 11.91 ± 2.37 for these techniques. The confidence interval for this score, which ranged from 11.46 to 12.37, showed an average level of adherence to infection control protocols. A clear correlation was studied between knowledge and practice scores among nurses managing neutropenic patients. In poor practice, 25% had poor knowledge, 60% moderate, and 15% good, suggesting that most had only moderate understanding. For moderate practice, 7.9% had poor, 47.4% moderate, and 44.7% good knowledge, indicating that better knowledge is associated with improved practices. In good practice, 12.8% had poor, 17.0% moderate, and 70.2% good knowledge, showing a strong link between high knowledge and effective practices. Higher practice levels are substantially correlated with higher knowledge scores, as indicated by the Pearson Chi-Square value of 20.975 and p-value of <0.001, which show a statistically significant association between practice and knowledge levels. This strong correlation between practice score and knowledge score is supported by the p-value (asymptotic significance) of 0.000, which is less than the conventional alpha threshold of 0.05 (Table 2).

Table 2: Contingency Table and Chi-Square Test Results

Category		Knowledge Score			
		Poor Knowledge	Moderate Knowledge	Good Knowledge	p-value
Practice Score	Poor Practice	5 (25%)	12 (60%)	3 (15%)	<0.001
	Moderate Practice	3 (7.9%)	18 (47.4%)	17 (44.7%)	
	Good Practice	6 (12.8%)	8 (17.0%)	33 (70.2%)	

DISCUSSION

This cross-sectional study assessed the knowledge and practice of the oncology and BMT nurses about neutropenic fever. The aims are to add to the body of literature concerning improving nursing education and training, and consequently patient care and outcomes. In the present study, the majority of participants were female (89.5%), with nearly half (47.6%) falling within the 31–40 age range. Similarly, a study conducted in Lebanon in 2021 reported that 77.8% of participants were female, with 44% in the 31 to 40 age range [10]. Additionally, another study in Ethiopia in 2022 found that 59.8% of participants were female, primarily in the 22 to 30 age range, further supporting the trend of a predominantly female nursing workforce in oncology [8]. In contrast, other studies reported that all participants in the oncology ward were female, suggesting a consistent female representation but differing age demographics within the nursing population [15, 16]. Regarding educational attainment, the current study revealed that 57.1% of participants held a bachelor's degree. Similarly, a study in Lahore, Pakistan, reported that 40% of participants had a bachelor's degree [12]. In contrast, a study in Turkey found that 100% of participants were with a bachelor's degree [15]. In the current study, the education and training provided to nurses for chemotherapy preparation showed notable variation. Specifically, 30.5% of respondents reported receiving training only once, while another 30.5% indicated they had never received any training at all. This aligns with findings from a 2022 study conducted in Muscat, which revealed that a significant majority of nurses had not participated in any educational programs related to oncology nursing (74.2%) or neutropenia (86.3%) [14]. The average knowledge score regarding neutropenia in the current study was 23.04 ± 4.0, indicating that nurses generally possess a good level of awareness. This is supported by a study [15]. that reported a mean knowledge score of 21.3 ± 2. In contrast, a study found a mean score of 16.3 out of 30 (SD=3.7), indicating moderate knowledge [14]. Another study reported a mean knowledge score of 15.9 (SD=1.72) [8]. Overall, more than half (64%) of the respondents in this study demonstrated poor knowledge regarding infection prevention for chemotherapy-induced neutropenia. Specific areas require targeted educational interventions, particularly in the management of stable patients and infection recognition. The current study found good adherence to infection control policies among nurses, with an average score of 11.91 ± 2.37, indicating substantial compliance with established protocols. However, identified gaps in infection control practices highlight the need for ongoing education and training to ensure comprehensive care for neutropenic patients. In contrast, a 2019 study on Iranian nurses' knowledge of neutropenia and their infection prevention practices reported only moderate practices, with just 19.2% demonstrating good practices [11]. This emphasizes the need for additional

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general education and training to enhance nurses' knowledge and clinical practices. Continuous education and training are recommended to better equip nurses with the knowledge and skills necessary for infection prevention. This is encouraging, as greater knowledge among nurses can lead to improved application of infection control measures. In the present study, 57.1% of nurses caring for neutropenic patients exhibited good hand hygiene practices, indicating strong adherence to infection control guidelines. However, 30.5% of practices were rated as moderate, and 12.4% were substandard, suggesting areas for improvement. These findings were supported by a study highlighting the role of comprehensive training programs in raising the level of knowledge and skills among nurses [5]. Hand hygiene is the most effective method for preventing healthcare-associated infections (HCAIs), yet compliance is often low, highlighting the need for effective improvement strategies [17]. In contrast, a study from Lahore found that only 44% of nurses demonstrated effective hand hygiene, highlighting a significant gap in infection prevention [12]. Another study's results showed, only 27.3% of nurses performed hand hygiene before patient contact, with 56.8% doing so afterwards [8]. These findings emphasize the need for targeted education and training to improve hand hygiene compliance, particularly before patient interactions, to better protect neutropenic patients and enhance treatment outcomes. Addressing these gaps is essential for enhancing infection control and protecting neutropenic patients, ultimately improving their treatment outcomes. In the current study, a significant positive relationship was observed between the knowledge and practices of oncology and BMT nurses in managing neutropenic patients. Chi-square analysis revealed p-values less than 0.001, indicating that as nurses' knowledge scores increased, their practice scores also improved. A study supports our finding which demonstrated a positive correlation between nurses' knowledge and their practices (r=0.75, p=0.001)[18]. Furthermore, our findings align with a qualitative study conducted in Norway, which found that oncology nurses with higher levels of cancer knowledge provided better nursing care, resulting in increased patient satisfaction [19]. However, contrary to our results, studies conducted in the USA and Iran reported no correlation between nurses' knowledge of neutropenia and their infection prevention practices [20]. This study has several limitations that should be considered when interpreting the results. The reliance on self-reported measures may have introduced response bias, as nurses might overstate their practices. Additionally, the census sampling method limits generalizability, as the sample was drawn from a single geographic area and may not represent other settings with different cultures and resources. Variability in institutional guidelines for managing neutropenic fever further complicates the ability to extrapolate best practices. Future research should employ observational methods for more reliable data and explore nurses' knowledge of chemotherapy-induced neutropenia (CIN), given the limited existing literature on this topic.

CONCLUSIONS

It was concluded that the research showed that, while there is some baseline knowledge about neutropenic fever among nurses, there are significant gaps in knowledge and practice. Continuous education and training programs would help the nurses learn from experts and keep themselves up-to-date regarding the changing guidelines and protocols on this very sensitive aspect of patient care. Such standardization of guidelines in all practice settings will minimize the variability in the practice and provide quality care. It is necessary to educate neutropenic fever to the patients and their families. Better quality educational literature may further engage the patients and family members in infection prevention and early symptom monitoring.

Authors Contribution

Conceptualization: SM
Methodology: SM, MAK, SB
Formal analysis: MAK, FK
Writing review and editing: SB

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

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