International Journal of Nursing and Health Care Research

OPEN ACCESS

Liu J, et al. Int J Nurs Health Care Res 7: 1580

www.doi.org/10.29011/2688-9501.101580

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Research Article

From Awareness to Action: The Role of Nurses in Combating Medical Device-Related Pressure Injuries

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Citation: Liu J, Yu C, Xue X, Yao D, Li W (2024) From Awareness to Action: The Role of Nurses in Combating Medical Device-Related Pressure Injuries. Int J Nurs Health Care Res 7:1580. DOI: https://doi.org/10.29011/2688-951.101580

Received Date: 20 September, 2024; **Accepted Date:** 30 September, 2024; **Published Date**: 03 October, 2024

Abstract

Objective: This study aimed to assess the knowledge, attitudes, and practices (KAP) of operating room nurses regarding the prevention of MDRPIs and to identify factors influencing their KAP levels. **Methods:** A cross-sectional survey was conducted using a convenience sample of 108 nurses from hospitals in Guangdong Province. The survey included a KAP questionnaire developed by Hu Yu Ding, which measures knowledge, attitudes, and behavior related to MDRPI prevention. Data were analyzed using SPSS 22.0, with multivariate linear regression to identify influencing factors. **Results:** The total KAP score for preventing MDRPIs was (137.46±25.78) points, with knowledge scoring (46.35±13.24), attitudes (37.54±6.22), and behavior (53.57±12.01). Regression analysis identified hospital level and gender as significant predictors of KAP levels (all $P<0.05$). Notably, nurses in higher-level hospitals and female nurses demonstrated better KAP. **Conclusion**: While operating room nurses exhibited a positive attitude towards MDRPI prevention, there is a need to improve their knowledge and behavior. Training programs should be tailored to address these gaps, particularly focusing on nurses in lower-level hospitals and male nurses. **Contribution:** This study contributes to the body of knowledge by providing insights into the specific educational needs of operating room nurses for MDRPI prevention and suggesting targeted interventions to enhance patient safety and reduce healthcare-associated complications.

Keywords: Operating room nurses; Medical device-related pressure injuries; Knowledge; Attitudes; Practices; Prevention strategies

Introduction

On April 13, 2016, the National Pressure Ulcer Advisory Panel (NPUAP) in the United States [1] officially transitioned from the term “pressure ulcer” to the more encompassing “pressure injury,” redefining it as localized damage to the skin and/or soft tissues that can occur over bony prominences or beneath medical devices. Such injuries may present as either intact skin or open ulcerations, potentially accompanied by pain, and are often the result of sustained or intense pressure, or a combination of pressure and shear forces. Concurrently, the NPUAP introduced the concept of “medical device-related pressure injury (MDRPI),” which specifically denotes injuries caused by the use of medical devices for diagnostic or therapeutic purposes, typically leaving damage patterns that correspond to the shape of the device in question. This new conceptualization has heightened clinical vigilance; however, despite advancements in medical technology and an increase in the use of medical consumables and equipment, the prevalence of MDRPI has risen, and yet the research in this domain remains sparse [2-4].

Particularly within the operating room, the diversity of instruments and consumables heightens the incidence of MDRPI compared to other hospital departments. However, existing clinical research disproportionately concentrates on Intensive Care Units (ICUs) [5-7], often sidelining the unique challenges of the operating room environment. The adage that prevention is superior to cure is especially pertinent to MDRPI, as its occurrence can adversely impact patients’ physical and psychological well-

being, potentially leading to secondary infections and irreversible harm. Consequently, this extends hospital stays and increases the consumption of medical resources. It is therefore imperative to provide comprehensive training to nursing staff. According to some studies, intraoperative MDRPIs constitute up to 45% of all hospital-acquired pressure injuries [8], and surgical patients are identified as a particularly vulnerable group, with incidence rates ranging from 0.2% to 61.9% [9]. The susceptibility of surgical patients to pressure injuries is attributed to a multitude of factors, including the inherent nature of their medical conditions, the employment of various pharmaceuticals and adjunctive treatment devices, the effects of anesthesia, and the necessity of preoperative fasting [10].

Further research indicates that aside from the material and design attributes of medical devices, the deficiency in preventive knowledge among operating room nurses, a suboptimal grasp of device-related risk factors, and a lack of both attention and effective preventive strategies significantly influence the incidence of MDRPI in surgical patients [11-14]. In light of these findings, the present study delves into the current state of knowledge, attitudes, and practices among operating room nurses. The goal is to establish a foundation for the development of targeted educational interventions aimed at enhancing preventive measures and improving patient outcomes.

Methods

Study Population

The study employed a convenience sampling technique to conduct a survey among healthcare facilities in Guangdong Province from July to August 2024. The survey targeted operating room nurses who met the following inclusion criteria: they held current nursing practice qualification certificates and were officially registered and actively employed in their respective roles. Exclusion criteria were applied to those nurses who were not present for duty during the survey period, such as those on prolonged sick leave, maternity leave, or involved in off-site academic activities exceeding three months. Consequently, the study enrolled a total of 108 eligible operating room nurses. Participation was voluntary, and all participants provided informed consent prior to their inclusion in the study.

Research Methods

Survey Instruments

The survey was administered using two primary tools. First, a general information questionnaire was utilized to collect demographic and professional data, including age, gender, years of service, professional titles, positions, educational backgrounds, hospital levels, marital statuses, and employment types of the participants.

Second, the Clinical Nurse Prevention of Medical Device-Related Pressure Injury (MDRPI) Knowledge, Attitude, and Practice (KAP) Scale, developed by Hu Yu Ding in 2017 [15], was employed. This comprehensive instrument encompasses three dimensions—knowledge, attitude, and behaviour-comprising 38 items in total. Scores range from 38 to 190, with higher scores reflecting a more advanced understanding and more effective attitudes and behaviors regarding MDRPI prevention among clinical nurses. The self-assessment questionnaire utilizes a 5-point Likert scale to quantify the responses, where 5 indicates 'extremely important' and 1 indicates 'not at all important'. The knowledge section assesses the depth of understanding from 'no knowledge' (1) to 'very knowledgeable' (5), the attitude section gauges agreement from 'strongly disagree' (1) to 'strongly agree' (5), and the behavior section evaluates the frequency from 'none' (1) to 'continuous' (5). The scale demonstrates robust internal consistency with a Cronbach's α coefficient of 0.962, and the dimensions range from 0.923 to 0.954, all exceeding the threshold for reliability. A subsequent study [6] confirmed the scale's reliability and validity with Cronbach's α coefficients of 0.954, 0.953, 0.933 for the dimensions, and 0.955 for the total scale, alongside a split-half reliability of 0.856 and a content validity of 0.957. The scores from the scale are categorized into three tiers of proficiency: low, medium, and high.

Data Collection Procedures

Data for this investigation were gathered via an electronic questionnaire designed to ensure anonymity by omitting fields for personal and hospital identification. The survey was structured such that all questions were mandatory, guiding participants with uniform language to elucidate the study's aims and significance. Completion was mandatory, ensuring comprehensive responses. Post-survey, researchers conducted a thorough review, amassing 108 valid questionnaires while excluding those with response times under 100 seconds, indicative of invalid or inattentive participation, as well as those exhibiting patterned responses or overt errors.

Statistical Analysis

Data were subjected to rigorous analysis utilizing SPSS software, version 22.0. Descriptive statistics, including frequencies and percentages, were employed to summarize the general data characteristics. To ascertain the normalcy of data distribution, appropriate tests were conducted. For comparative analyses between two groups, the independent samples t-test was applied when the data met the assumptions of normality. In instances of multiple group comparisons, one-way analysis of variance (ANOVA) was selected to discern significant differences.

Furthermore, multivariate linear regression analysis was engaged to delineate the determinants influencing the knowledge, attitudes, and practices of operating room nurses pertaining to the prevention of Medical Device-Related Pressure Injuries (MDRPI). This approach facilitated a comprehensive examination of the interplay between various independent variables and the dependent variables of interest.

Results

Demographic and Professional Characteristics of Participants

The respondent pool comprised 108 operating room nurses who participated in the survey. Basic demographic and professional data were collected, providing a comprehensive profile of the sample (Table 1).

project	Number of cases	Percentage (%)
Age (years) ≤26	25	23.2
27-	63	58.4
≥30	20	18.4
Gender: male	17	15.7
woman	91	84.3
Hospital grade two and below.	9	8.3
three-level	99	91.7
Length of service (year) < 5	48	44.4
45570	50	46.3
44105	7	6.5
>20	3	2.8
position nurse	104	96.3
head nurse	4	3.7
educational background		1.9
College degree or below	2	
Bachelor degree or above	106	98.1
Marital status unmarried	69	63.9
married	39	36.1
employment status on the establishment	7	6.5
outside the establishment	101	93.5
Professional title nurse	4	3.7
primary nurse	87	80.6
Nurse-in-charge	17	15.7

Table 1: General information of the respondents.

Evaluation of the KAP Scores in Preventing Medical Device-Related Pressure Injuries

The aggregate KAP (Knowledge, Attitude, Practice) scores of the participants in the prevention of Medical Device-Related Pressure Injuries (MDRPI) were calculated, yielding a mean score of 137.46 with a standard deviation of 25.78, corresponding to an overall scoring rate of 72.3%. The distribution of scores across the dimensions was as follows: the knowledge dimension achieved a mean score of 46.35 with a standard deviation of 13.24, translating to a scoring rate of 61.8%; the attitude dimension had a mean score of 37.54 with a standard deviation of 6.22, and a scoring rate of 83.4%; and the behavior dimension scored a mean of 53.57 with a standard deviation of 12.01, with a scoring rate of 76.5%. For a detailed breakdown, refer to Table 2. Table 3 presents the items within each dimension that received the lowest scores.

project	Number of entries (points)	Total score of items (points)	Score (points)
knowledge	15	75	46.35±13.24
faith; belief	nine	45	37.54±6.22
behaviour	14	70	53.57±12.01
Total score of scale	38	190	137.46±25.78

Note: MDRPI refers to pressure injury related to medical devices.

Table 2: KAP scores of nurses in operating room for preventing MDRPI (points).

dimension	clauses and sub-clauses	Score (points, ±SD)
knowledge	10. You took the initiative to learn about the related knowledge of medical device-related stress injury.	2.81±1.05
	11. You have participated in academic lectures or training on medical device-related stress injuries.	2.67±1.07
	12. You have cared for patients with medical device-related stress injuries.	2.66±1.08
attitude	1. Participating in training helps nurses to better prevent the occurrence of medical device-related stress injuries.	4.11±0.79
	3. Most medical device-related stress injuries can be avoided.	4.01±0.83
	4. Continuous evaluation is beneficial to prevent the occurrence of medical device-related stress injury.	4.06±0.77
behaviour	2. When you are nursing patients who use ECG monitor, you will change the blood oxygen saturation finger cuff every two hours and put it on different fingers of the patient alternately.	3.34±1.05
	7. For patients who need to continuously monitor blood pressure, according to the actual situation of the patient, if the condition permits, you should open the cuff every 1-2 hours and relax for 10-15 minutes.	3.44±1.23
	10. Traditional pressure injuries and medical device-related pressure injuries are reported separately.	3.56±1.22

Table 3: The three items with the lowest scores in each dimension of MDRPI knowledge, attitude and behavior scale for clinical nurses to prevent critically ill patients (n=108).

Comparative Analysis of KAP Scores

Utilizing the basic data of the nurses as independent variables, the study analyzed the variances in knowledge, attitude, behavior, and total KAP scores among nurses with distinct characteristics. Statistically significant differences were observed ($P < 0.05$). Specifically, when comparing nurses across different hospital grades, the knowledge dimension scores for MDRPI prevention were notably different ($P < 0.05$). Similarly, significant variations were found in the attitude and behavior dimension scores related to MDRPI prevention among nurses of different positions and hospital grades ($P < 0.05$), as detailed in Table 4.

project	Knowledge dimension	Attitude dimension	Behavior dimension	Total score of knowledge, belief and bank
Age (years)≤26	45.52±10.09	37.72±4.94	52.16±9.51	135.4±15.98
27～	46.35±13.89	37.46±6.90	53.86±13.06	137.67±28.43
≥30	47.40±15.07	37.55±5.64	54.45±11.72	139.40±26.75
variance ratio	0.11	0.015	0.241	0.138
P value	0.896	0.985	0.787	0.871
Gender: male	44.23±13.74	34.47±9.50	47.35±13.19	126.06±32.26

woman	46.75±13.18	38.11±5.27	54.74±11.48	139.59±23.74
T value	-0.717	-2.255	-2.377	-2.032
P value	0.475	0.026	0.019	0.045
Marital status unmarried	44.99±12.87	37.83±6.36	52.87±12.58	135.68±26.02
married	48.77±13.69	37.03±6.02	54.82±10.96	140.62±24.79
T value	-1.434	0.64	-0.81	-0.963
P value	0.155	0.523	0.42	0.338
Length of service (year) <5	47.23±12.05	37.33±6.64	52.08±10.87	136.65±23.76
45570	44.62±14.54	37.56±5.92	54.94±13.28	137.12±28.02
44105	54.00±12.46	39.29±5.15	52.57±10.36	145.86±24.86
>20	43.33±2.08	36.33±9.02	57.00±13.08	136.67±19.66
T value	1.193	0.234	0.553	0.266
P value	0.316	0.873	0.647	0.85
Professional title nurse	46.00±5.35	35.75±1.71	49.50±5.45	131.25±5.19
primary nurse	46.10±13.29	37.47±6.53	53.76±12.37	137.33±26.19
Nurse-in-charge	47.71±14.63	38.29±5.25	53.59±11.46	139.59±25.87
variance ratio	0.104	0.292	0.237	0.175
P value	0.901	0.748	0.789	0.84
position nurse	46.49±13.4	37.67±6.29	53.67±12.16	137.84±25.97
head nurse	42.75±7.76	34.00±1.41	51.00±6.98	127.75±6.85
T value	0.553	1.16	0.435	0.772
P value	0.528	0.003	0.664	0.049
Educational background College degree or below	51.50±2.12	30.50±4.95	56.00±19.80	138.00±12.72
Bachelor degree or above	46.25±13.34	37.67±6.19	53.53±11.96	137.45±25.79
T value	0.553	-1.627	0.287	0.03
P value	0.581	0.107	0.775	0.976
Hospital grade two and below	35.22±13.54	32.78±9.22	43.22±14.22	111.22±31.64
three-level	47.36±12.80	37.97±5.75	54.52±11.41	139.85±23.74
T value	-2.712	-2.452	-2.786	-3.366
P value	0.008	0.016	0.006	0.001
employment status	47.14±7.80	34.00±6.93	51.43±9.50	132.57±16.87
on the establishment				
outside the establishment	46.29±13.56	37.78±6.13	53.72±12.19	137.80±26.10

T value	0.163	-1.566	-0.487	-0.521
P value	0.871	0.12	0.627	0.603

Table 4: Comparison of KAP scores of nurses in operating room to prevent medical device-related stress injury (n=108, min, s) $\bar{x}$.

Multivariate Analysis of KAP Scores Influencing MDRPI Prevention

Multivariate linear regression analysis was conducted based on the outcomes of univariate analyses. Gender, position, and hospital level were considered as independent variables, while the knowledge, attitude, and practice related to MDRPI prevention were treated as dependent variables. Gender was coded as 1 for male and 2 for female; position was coded as 1 for duty nurse and 2 for head nurse; hospital level was coded as 1 for secondary or lower and 2 for tertiary. The results of the multiple linear stepwise regression analysis are delineated in Table 5.

Dependent variable	Independent variable	B value	Standard error	β value	T value	P value
Knowledge dimension [1)]	constant	23.081	8.67	—	2.662	0.009
	Hospital grade	12.141	4.477	0.255	2.712	0.008
Attitude dimension [2)]	constant	21.717	4.851	—	4.477	<0.001
	gender	3.438	1.582	0.202	2.174	0.032
	Hospital grade	4.949	2.084	0.221	2.375	0.019
Behavior dimension [3)]	constant	20.076	9.264	—	2.176	0.032
	gender	6.943	3.021	0.212	2.299	0.024
	Hospital grade	10.802	3.98	0.25	2.714	0.008
[1)] r = 0.065, adjust R^2= 0.056, F=7.355, p = 0.008; [2)] R = 0.094, adjust R^2=0.077, F=5.474, P = 0.005; [3)] R = 0.113, adjust R^2=0.096, F=6.679, P=0.002.						

Table 5: results of multivariate analysis of nurses' knowledge, attitude and behavior score in preventing MDRPI in operating room.

Discussion

Attitudinal and Behavioral Insights into Operating Room Nurses' Prevention of Medical Device-Related Stress Injuries

Knowledge Gaps in MDRPI Prevention Among Operating Room Nurses

The dimension of knowledge regarding the prevention of Medical Device-Related Pressure Injuries (MDRPI) among operating room nurses is critical, encompassing understanding of the concept, stages, risk factors, assessment, prevention, and treatment protocols [16]. This knowledge directly impacts nurses' ability to identify, prevent, and manage MDRPI and provide quality patient care. Our findings indicate that the mean knowledge dimension score was 46.35±13.24, with a scoring rate of 61.8%, which is lower than previous studies [17-19]. This suggests a pressing need to enhance the knowledge base of operating room nurses. The lowest scoring items relate to proactive learning about MDRPI, participation in relevant training, and care for patients with MDRPI. It is imperative for nursing management to develop robust educational initiatives, including seminars and specialized training, to elevate nurses' comprehension and clinical application of MDRPI prevention strategies.

Positive Attitudes with Room for Behavioral Improvement

The attitude dimension reflects the level of importance nurses assign to MDRPI prevention. With a mean score of 37.54±6.22 and a scoring rate of 83.4%, our results indicate a positive, yet not optimal, attitude towards MDRPI prevention—slightly below the provincial average of 86.9% [17]. Despite a demonstrated understanding of MDRPI's significance, there is a discernible gap in the pre-emptive measures taken. Nursing administrators should prioritize ongoing education and establish MDRPI prevention as a key performance indicator for nursing quality. Implementing a structured reward system may bolster nurses' commitment and motivation to uphold MDRPI prevention standards.

Discrepancy Between Attitude and Behavioral Outcomes

The behavior dimension, with a mean score of 53.57±12.01 and a scoring rate of 76.5%, slightly exceeds that of other studies [6]. However, the discrepancy between the high attitude scores and the behavior scores suggests a shortfall in the practical application of MDRPI prevention measures. This may stem from a lack of knowledge and accessible clinical tools for assessment. The lowest scoring behavioral items indicate deficiencies in the timely replacement of medical devices and body part repositioning, potentially due to the constraints of surgical positions and procedures. Preoperative comprehensive assessments and stringent preventive measures are recommended to bridge this gap. Additionally, the underreporting of MDRPI in hospital records may reflect reporting system inadequacies, underscoring the need for an integrated management and information system to enhance nurses' decision-making and execution in MDRPI prevention.

Influencing Factors on Nurses' KAP in MDRPI Prevention

Impact of Hospital Level on Nurses' KAP

The multivariate analysis revealed that nurses in secondary hospitals scored lower on the KAP scale compared to their counterparts in tertiary hospitals, indicating a disparity in knowledge and preventive practices. This may be attributed to the concentration of educational resources and the emphasis placed by nursing management in tertiary institutions. The higher prevalence of stress injuries in secondary hospitals [20] underscores the urgency to bolster nursing education and management, particularly in secondary care settings.

Gender Differences in KAP for MDRPI Prevention

The analysis also indicated that female nurses outperformed their male colleagues across all KAP dimensions, aligning with findings by Wei Xiaojing et al. [6,21]. This suggests a need to tailor educational programs to address the specific needs of male nurses, given the superior behavioral compliance and meticulous nature commonly associated with female nurses.

Limitations of the Study

The present study employed a convenience sampling method, which may limit the generalizability of the findings due to a small and demographically concentrated sample. Additionally, the regional focus may restrict the representativeness of the sample. Future research should expand the scope and explore a broader range of influencing factors to provide a more comprehensive understanding of MDRPI prevention in operating rooms.

Conclusion

This study concludes that operating room nurses in Guangdong province exhibit a commendable positive attitude towards the prevention of Medical Device-Related Pressure Injuries (MDRPI). However, there is a discernible need to enhance their levels of knowledge and behavioral practices. The findings identify hospital level and gender as pivotal factors influencing the nurses' knowledge base in MDRPI prevention.

It is imperative for nursing management to implement diverse educational programs grounded in the theoretical framework of knowledge, attitudes, and practices (KAP). Such initiatives should be aimed at equipping operating room nurses with the necessary knowledge, fortifying their convictions, and refining behaviors that are instrumental in the prevention of MDRPI. By doing so, these efforts will not only bolster individual competencies but also foster the development and implementation of effective prevention and intervention strategies.

The integration of such programs is expected to elevate the overall quality of nursing care, contributing to a reduction in MDRPI incidence and the associated morbidity in surgical settings. Continuous education and professional development will ensure that nurses remain at the forefront of patient safety and comfort, aligning with the evolving standards of modern healthcare.

Acknowledgments

I would like to express my sincere gratitude to all those who have supported and assisted me in the completion of this thesis. Special thanks go to my colleagues and fellow researchers , who have provided a stimulating and collaborative environment. Their camaraderie and support have made the journey of research both enjoyable and rewarding.

Declaration

The authors declare that they have no competing interests.

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