

ORIGINAL ARTICLE

Intensive care nurses' knowledge and practices regarding medical device-related pressure injuries: A descriptive cross-sectional study

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Abstract

This study aims to determine the levels of knowledge and practices of intensive care nurses regarding medical device-related pressure injuries (MDRPIs). This descriptive cross-sectional study was carried out between September 2023 and February 2024, involving 143 nurses working in intensive care units across three hospitals in Türkiye. The data were collected using the demographic form and the Medical Device-related Pressure Injuries Knowledge and Practice Assessment Tool (MDPI-ASSET). Of the nurses, 74.1% have encountered MDRPIs in their unit, 63.6% feel that their knowledge about MDRPIs is insufficient and 90.2% express a desire to receive training about MDRPIs. The participants' total mean MDPI-ASSET score was 11.12 (out of 21). The nurses achieved the highest mean score on the Aetiology/risk factors sub-scale and the lowest mean score on the Staging sub-scale. The analysis revealed significant differences in the mean MDPI-ASSET total scores among nurses based on the status of previous encounters with MDRPIs ($t = 2.342$; $p = 0.021$) and their feelings of responsibility for the development of MDRPIs ($t = -2.746$; $p = 0.007$). In this study, the knowledge and practices of intensive care nurses regarding medical device-induced pressure injuries were found to be inadequate. Given the frequent occurrence of MDRPIs in intensive care units, it is necessary to support nurses with continuous organizational-level training to improve the quality of care for critically ill patients.

KEYWORDS

intensive care units, medical device-related pressure injuries, nurse, pressure ulcer

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Key Messages

- Intensive care nurses play a primary role in evaluating patients at risk of medical device-related pressure injuries (MDRPis).
- The knowledge and practices of intensive care nurses regarding MDRPis were found to be inadequate.
- Intensive care nurses require ongoing training on MDRPis.
- Healthcare institutions should implement continuous plans to support and improve nurses' knowledge and practices related to MDRPis.

1 | INTRODUCTION

Medical devices play an integral role in the provision of healthcare services and serve a multitude of purposes from prevention to treatment across various healthcare settings.^{1,2} Individuals connected to a medical device are at high risk of device-related pressure injuries (PIs).³ Medical device-related pressure injuries (MDRPis) refer to localized skin or subcutaneous tissue injuries caused by sustained pressure from a medical device.¹

Previous studies reported that MDRPis are most commonly observed in intensive care units (ICUs).^{4,5} In this regard, studies conducted in various countries have reported that the prevalence of MDRPis among intensive care patients is significant, ranging between 5.01% and 62.4%.^{6–15} Primary risk factors associated with the development of MDRPis include high frequency, prolonged duration and extensive use of medical devices for life support and critical disease treatment in ICUs.^{9,13,16} Coyer et al.¹⁰ conducted a prevalence study and reported that each increment in the number of devices used for ICU patients correlates with a 23% increase in the likelihood of developing MDRPis, while each increase in the number of hospitalization days corresponds to a 5% increase. Furthermore, various factors have been reported as significant risk factors for the development of MDRPis in intensive care patients, including vasopressor use, high APACHE II score, low Braden Scale score, skin edema, parenteral nutrition, diabetes mellitus and polypharmacy.^{8,11,17} MDRPis can develop in any anatomical area where the skin comes into contact with a medical device.¹⁸ Studies conducted in ICUs have identified that the anatomical locations where MDRPis commonly develop are fingers, nose, mouth, lips, cheeks, ears, sacrum, urethral meatus, hands, arms, legs, heels,^{9,11–13} and are often attributed to the use of non-invasive ventilation masks, nasogastric/nasojejunal tubes, endotracheal tubes, pulse oximeter probes, intravenous catheters, urinary catheters and orthopaedic devices.^{6–10,12–14}

In the prevention and treatment of PIs/MDRPis, it is recommended to assess nutrition and hydration, use support surfaces, select and place medical devices of

appropriate size and design, inspect the skin under and around medical devices, keep the skin beneath medical devices clean and dry, reposition the patient and/or medical device as needed and provide appropriate support for the medical device.³ As one of the active practitioners of these practices, nurses play a crucial role in identifying patients at risk of complications associated with medical device use and in preventing potential adverse outcomes.¹⁹ This suggests that nurses should have adequate knowledge and skills. MDRPis have significant physical and psychological consequences for patients, impact their overall well-being and eventually lead to considerable increases in healthcare costs.^{20,21} Accordingly, MDRPis serve as primary indicators of patient safety and nursing quality in healthcare settings.²¹ Consequently, a high prevalence of MDRPis may indicate inadequate quality of nursing care. This is why intensive care nurses should identify risk factors for MDRPis and implement appropriate preventative measures.¹¹ Assessing the knowledge levels and practices of intensive care nurses regarding MDRPis, improving inadequate and inappropriate practices and enhancing their MDRPI knowledge are important for improving the quality of care for critically ill patients. This study aims to determine the knowledge and practices of intensive care nurses regarding MDRPis.

2 | MATERIALS AND METHODS

2.1 | Study design

A descriptive cross-sectional study was designed.

2.2 | Setting and participants

The study was designed as multicentre research and was carried out from September 2023 to February 2024 in a university hospital and two training and research hospitals located in three distinct provinces of Türkiye. The

study population comprised 190 nurses with a minimum of 1 year's experience in adult and neonatal ICUs (including Surgical ICU, Neurology ICU, General ICU, Internal ICU, Respiratory ICU, Anaesthesia and Reanimation ICU, Coronary ICU and Neonatal ICU) across the participating hospitals. To assess the intensive care nurses' knowledge and practices regarding MDRPIs, the study was conducted in the ICUs of three hospitals considering the frequent use of multiple and varied medical devices (including respiratory devices, monitoring devices and various catheters) in the routine follow-up and treatment of intensive care patients. The non-probability-based purposive sampling method was used for selection of the participants. The sample size was determined using the formula $[n = \chi^2 N P (1 - P)/e^2 (N - 1) + \chi^2 P (1 - P)]$ proposed by Krejcie and Morgan,²² a commonly utilized method for known population sizes. Accordingly, the minimum sample size required was calculated to be 127 with a 95% confidence interval and a 5% margin of error ($N/\text{Population size} = 190$; $\chi^2/\text{Chi-square table value} = 3841$; $P/\text{Population proportion} = 0.5$; $e/\text{Margin of error} = 0.05$).²² The study was conducted with a total of 143 nurses who voluntarily agreed to participate.

2.3 | Data collection

The data were collected using the demographic form and the Medical Device-related Pressure Injuries Knowledge and Practice Assessment Tool (MDPI-ASSET). The ICUs of the participating hospitals were visited, and nurses were informed about the study's purpose. Nurses were then invited to participate. Those who volunteered were provided with detailed information about the study, including its purpose, the measurement tools, the estimated time required to complete the data collection instruments and the participation process (voluntary nature of participation, confidentiality of participant information, right to withdraw from research). Subsequently, a written informed consent form containing relevant information was provided to participants for review and written approval. The data collection tools were administered to nurses who provided both verbal and written consent to participate. Data were collected face-to-face in the nurses' lounge within the ICUs. To ensure participants were not influenced by one another and to maintain the confidentiality of the data and the privacy of the participants, only the researcher and the participant were present in the room during data collection. The forms were completed anonymously by the participants, and no identifying information was collected.

2.3.1 | Demographic form

This form was prepared by the researchers based on the literature to measure nurses' socio-demographic and professional characteristics, as well as experiences on MDRPIs.^{23,24}

2.3.2 | Medical device-related PIs knowledge and practice assessment tool

The tool is composed of 21 items across three sub-scales namely, Aetiology/risk factors (seven items: 1–7), Prevention interventions (seven items: 8–14) and Staging (seven items: 15–21). Each item consisted of four answer options (one correct answer and three alternative answer distractors). Some items in the tool use case studies (four items) and some use visual images (six items). Participants scored one point for each correct answer and 0 points for each incorrect answer. The minimum score that can be obtained from each sub-scale is 0 and the maximum score is 7. The score that can be obtained from the scale ranges between 0 and 21 and no specific cut-off value is proposed to represent adequate or good knowledge.²⁵

The Cronbach's alpha internal consistency coefficient of the scale was reported to be 0.54.²⁵ Despite the low Cronbach's alpha coefficient of this instrument, the MDPI-ASSET was selected for this study due to its good test-retest reliability, the high content validity of the sub-scales and its availability in the Turkish language. Furthermore, the detailed focus of the scale items on the relevant topic made it the most appropriate instrument for our research objectives. Permission to use the instrument was obtained from the instrument's developer via email.

2.4 | Data analysis

Data were analysed via IBM Statistical Package for the Social Sciences (SPSS) Statistics for Windows, Version 25.0 software. Compliance with normal distribution was assessed according to Kolmogorov–Smirnov test. For the analysis of data, One-Way ANOVA and Independent Samples *t*-test were employed for between-group comparisons. The homogeneity of variances was assessed by Levene's test. Bonferroni corrections were used for comparisons involving more than two groups. Analysis results were reported as mean, standard deviation (SD) and median (minimum–maximum). The reliability of the scale was assessed via Cronbach's alpha coefficient. Significance values were taken as <0.05 .

TABLE 1 Descriptive characteristics of the nurses ($n = 143$).

Characteristics	<i>n</i>	%
Gender		
Female	89	62.2
Male	54	37.8
Age		
23–29 years	58	40.6
30–40 years	62	43.4
41 years and above	23	16.1
Education level		
High school	16	11.2
Associate degree ^a	15	10.5
Bachelor's degree	91	63.6
Postgraduate degree	21	14.7
Years of professional service		
1–5 years	41	28.7
6–10 years	40	28.0
11–20 years	50	35.0
21 years and above	12	8.3
Type of the ICU		
Adult surgical ICUs	30	21.0
Adult internal ICUs	90	62.9
Neonatal ICUs	23	16.1
Length of service in ICUs		
1–5 years	71	49.7
6–10 years	42	29.4
11 years and above	30	21.0
Working time per week		
40 h	56	39.2
48 h	31	21.7
56 h	56	39.2
Do you encounter MDRPIs in your unit?		
Yes	106	74.1
No	37	25.9
Do you feel responsible for the development of MDRPIs?		
Yes	107	74.8
No	36	25.2
Do you believe that MDRPIs can be prevented with nursing care?		
Yes	107	74.8
No	11	7.7
Not sure	25	17.5
Have you received any training on MDRPIs?		
Yes	56	39.2
No	87	60.8
Do you believe that your knowledge of MDRPIs is sufficient?		

TABLE 1 (Continued)

Characteristics	<i>n</i>	%
Yes	52	36.4
No	91	63.6
Would you like to attend a training on MDRPIs?		
Yes	129	90.2
No	14	9.8

Abbreviations: ICU, intensive care unit; MDRPIs, medical device-related pressure injuries.

^aAssociate degree: Refers to graduates of a 2-year nursing programme of the universities.

TABLE 2 Mean Medical Device-related Pressure Injuries Knowledge and Practice Assessment Tool (MDPI-ASSET) scores of the nurses.

MDPI-ASSET	Mean (SD)	Median (min-max)
Aetiology/risk factors	4.32 (1.48)	5 (0-7)
Prevention interventions	3.90 (1.40)	4 (0-7)
Staging	2.89 (1.12)	3 (0-6)
Total	11.12 (2.62)	11 (4-17)

Abbreviations: Max, maximum; Min, minimum; SD, standard deviation.

2.5 | Ethical considerations

Permission to conduct the study was obtained from the Non-Interventional Clinical Research Ethics Committee of Amasya University (7 September 2023/No: 2023/107). Additionally, written permission was obtained from the hospitals (14 September 2023/No: E-62949364-903.07.02-224482464; 12 September 2023/No: 337649; 14 September 2023/No: E-68051626-949-224435227), where the study was conducted. Verbal and written informed consent was received from all participants. The study was carried out following the principles outlined in the Declaration of Helsinki.

3 | RESULTS

Among the participating nurses, 62.2% ($n = 89$) were female and 63.6% ($n = 91$) had a bachelor's degree. The mean age of the nurses was 32.58 years (SD 6.93, range 23-53) with a mean length of service in the profession of 10.54 years (SD 7.13, range 1-33) and a mean length of service in the ICU of 7.06 years (SD 5.22, range 1-23). Of the nurses, 74.1% ($n = 106$) have encountered MDRPIs, 74.8% ($n = 107$) feel responsible for the occurrence of MDRPIs and the same percentage believe that MDRPIs can be prevented with nursing care. However, 60.8% ($n = 87$) have not received any training about MDRPIs, 63.6% ($n = 91$) feel that their level of

knowledge about MDRPIs is insufficient and 90.2% ($n = 129$) express a desire to receive training about MDRPIs (Table 1).

The participants' total mean MDPI-ASSET score was 11.12 (SD = 2.62, range = 4-17). The mean scores for the sub-scales were 4.32 (SD = 1.48, range = 0-7) for Aetiology/risk factors, 3.90 (SD = 1.40, range = 0-7) for Prevention interventions and 2.89 (SD = 1.12, range = 0-6) for Staging (Table 2). The correct-incorrect distribution of participants' responses to the instrument is provided in Table 3.

Gender, age, educational level, years of professional service, and length of service in the ICU were not associated with MDPI-ASSET total score or the sub-scale scores ($p > 0.05$) (Table 4). However, encountering MDRPIs significantly affected both the total scale score ($t = 2.342$; $p = 0.021$) and the Prevention interventions sub-scale score ($t = 2.731$; $p = 0.007$). Similarly, those who felt responsible for the occurrence of MDRPIs had significant changes in their total scale score ($t = -2.746$; $p = 0.007$) and Aetiology/risk factors sub-scale score ($t = -2.323$; $p = 0.022$). Moreover, participants who expressed a desire for MDRPI training showed significantly higher mean Prevention interventions sub-scale score ($t = 2.818$; $p = 0.006$) (Table 5).

In this study, Cronbach's alpha internal consistency coefficient of the MDPI-ASSET was calculated as 0.40.

4 | DISCUSSION

Multiple and prolonged use of medical devices makes ICU patients vulnerable to MDRPIs.^{3,10,20} In this study, 74.1% of the nurses reported encountering MDRPIs in the ICU where they worked. Such frequent encounters with MDRPIs in ICUs necessitate the intensive care team to have awareness, knowledge and competence regarding risk factors and prevention practices associated with MDRPIs.

The nurses' knowledge and practice score regarding MDRPIs was determined to be 11.12. Considering that

Sub-scales	Items	Correct answer <i>n</i> (%)	Incorrect answer <i>n</i> (%)
Aetiology/risk factors	1	108 (75.5)	35 (24.5)
	2	90 (62.9)	53 (37.1)
	3	98 (68.5)	45 (31.5)
	4	65 (45.5)	78 (54.5)
	5	57 (39.9)	86 (60.1)
	6	97 (67.8)	46 (32.2)
	7	103 (72.0)	40 (28.0)
Prevention interventions	8	111 (77.6)	32 (22.4)
	9	39 (27.3)	104 (72.7)
	10	103 (72.0)	40 (28.0)
	11	107 (74.8)	36 (25.2)
	12	66 (46.2)	77 (53.8)
	13	107 (74.8)	36 (25.2)
	14	26 (18.2)	117 (81.8)
Staging	15	71 (49.7)	72 (50.3)
	16	8 (5.6)	135 (94.4)
	17	53 (37.1)	90 (62.9)
	18	52 (36.4)	91 (63.6)
	19	31 (21.7)	112 (78.3)
	20	120 (83.9)	23 (16.1)
	21	79 (55.2)	64 (44.8)

TABLE 3 The correct-incorrect distribution of participants' responses to the Medical Device-related Pressure Injuries Knowledge and Practice Assessment Tool (*n* = 143).

the maximum score that can be obtained from the measurement tool is 21, it can be argued that nurses do not have the desired level of knowledge and practice. Greater knowledge and positive attitudes among nurses towards PIs may lead to better practices for their prevention.²⁶ Therefore, having sufficient knowledge about MDRPIs will enable nurses to perform comprehensive and effective practices for prevention and care of MDRPIs, which in turn contributes to an improved quality of care for critically ill patients.

In this study, 60.8% of the participants reported not having received any training on MDRPIs, 63.6% believed their level of knowledge was insufficient and 90.2% expressed a desire to receive training. Our findings indicate that nurses have training needs regarding MDRPIs. In the literature, only a limited number of studies have been conducted on the knowledge, perception, attitude and awareness of MDRPIs among intensive care nurses. Similar to our findings, almost all of these studies reported that ICU nurses' knowledge, perceptions, attitudes and practices regarding MDRPIs were inadequate.^{23,24,27,28} On the contrary, Zhang et al.²⁹ found that the knowledge, attitudes and practices of ICU nurses in China regarding MDRPIs were at an acceptable level.

These differences in the knowledge and practice levels of nurses regarding MDRPIs may be attributed to the differences in the years of professional experience, education level and level of training on MDRPIs.

The use of multiple devices for monitoring and treatment is inevitable in ICUs. While factors related to medical device use—such as the number, type, design and location of devices—are primary risk factors for the development of MDRPIs, many other factors can also contribute to their occurrence in these settings. MDRPIs may result from both patient-related factors (e.g., age, length of stay in the ICU, presence of edema, Braden score, malnutrition, poor perfusion) and treatment- and care-related factors (e.g., type of ICU, use of vasopressors, correct device positioning, frequency of skin assessment, frequency of repositioning).^{3,11,15,18} Due to the numerous aetiological and risk factors, as well as the various preventative measures applied, the prevalence of MDRPIs can vary across ICUs. Knowledge and awareness of these aetiological and risk factors are essential for implementing effective preventative measures. The mean Aetiology/risk factors sub-scale score of the nurses was found to be greater than the other sub-scale scores. Identifying risk factors for PIs constitutes the initial step in preventing

TABLE 4 Comparison of the nurses' descriptive characteristics with their Medical Device-related Pressure Injuries Knowledge and Practice Assessment Tool scores.

Variable	Total scale Mean (SD)	Aetiology/risk factors Mean (SD)	Prevention interventions Mean (SD)	Staging Mean (SD)
Gender				
Female	11.28 (2.49)	4.38 (1.45)	3.94 (1.37)	2.96 (1.15)
Male	10.87 (2.84)	4.22 (1.54)	3.85 (1.47)	2.80 (1.09)
Test and <i>p</i> -value	$t = 0.907; p = 0.366$	$t = 0.624; p = 0.533$	$t = 0.379; p = 0.706$	$t = 0.818; p = 0.415$
Age				
23–29 years	11.16 (2.65)	4.52 (1.67)	3.78 (1.34)	2.86 (1.16)
30–40 years	11.16 (2.47)	4.18 (1.26)	4.08 (1.45)	2.90 (1.13)
41 years and above	10.96 (3.04)	4.22 (1.54)	3.78 (1.44)	2.96 (1.07)
Test and <i>p</i> -value	$F = 0.057; p = 0.945$	$F = 0.815; p = 0.427$	$F = 0.815; p = 0.445$	$F = 0.060; p = 0.942$
Education level				
High school	10.69 (2.68)	4.00 (1.71)	3.81 (1.22)	2.88 (0.96)
Associate degree	9.33 (2.50)	3.60 (1.68)	3.33 (1.23)	2.40 (1.12)
Bachelor's degree	11.49 (2.49)	4.56 (1.37)	3.98 (1.48)	2.96 (1.16)
Postgraduate degree	11.14 (2.83)	4.05 (1.47)	4.10 (1.26)	3.00 (1.05)
Test and <i>p</i> -value	$F = 3.233; p = 0.024^*$	$F = 2.550; p = 0.058$	$F = 1.064; p = 0.367$	$F = 1.125; p = 0.341$
Years of professional service				
1–5 years	11.49 (2.68)	4.66 (1.65)	3.83 (1.38)	3.00 (1.20)
6–10 years	10.78 (2.65)	4.20 (1.47)	3.88 (1.52)	2.70 (1.14)
11–20 years	11.36 (2.46)	4.30 (1.27)	4.08 (1.32)	2.98 (1.06)
21 years and above	10.08 (2.91)	3.67 (1.61)	3.58 (1.51)	2.83 (1.11)
Test and <i>p</i> -value	$F = 1.272; p = 0.286$	$F = 1.605; p = 0.191$	$F = 0.509; p = 0.677$	$F = 0.623; p = 0.601$
Type of the ICU				
Adult surgical ICUs	11.06 (2.54)	4.23 (1.71)	4.00 (1.33)	2.83 (0.87)
Adult internal ICUs	11.27 (2.63)	4.45 (1.41)	3.90 (1.43)	2.92 (1.21)
Neonatal ICUs	10.60 (2.70)	3.91 (1.37)	3.82 (1.40)	2.86 (1.05)
Test and <i>p</i> -value	$F = 0.603; p = 0.549$	$F = 1.303; p = 0.275$	$F = 0.104; p = 0.902$	$F = 0.076; p = 0.926$
Length of service in ICUs				
1–5 years	11.14 (2.80)	4.49 (1.57)	3.79 (1.44)	2.86 (1.27)
6–10 years	10.88 (2.53)	4.00 (1.43)	4.05 (1.41)	2.83 (0.99)
11 years and above	11.43 (2.33)	4.37 (1.30)	4.00 (1.31)	3.07 (0.94)
Test and <i>p</i> -value	$F = 0.387; p = 0.679$	$F = 1.491; p = 0.229$	$F = 0.0525; p = 0.593$	$F = 0.446; p = 0.641$

Note: Bonferroni correction was applied in the comparison of groups.

Abbreviations: *F*, One-Way ANOVA; ICU, intensive care unit; SD, standard deviation; *t*, Independent Samples *t*-test.

*Bonferroni correction significance value was set at $p < 0.012$.

such injuries.¹⁶ Based on our findings, it can be argued that nurses have knowledge about the reasons and risk factors for MDRPIs.

In this study, it was found that nurses' Prevention interventions scores were lower than Aetiology and risk factors scores. Despite nurses having knowledge about Aetiology and risk factors, their low score on the Prevention interventions sub-scale is a disconcerting result. Kim

et al.³⁰ reported that clinical nurses' perception scores of the importance of preventing MDRPIs were high, while their prevention performance scores were low. Saleh et al.³¹ reported that, despite nurses having adequate knowledge about PIs, their preventative measures were found to be insufficient. This finding highlights a gap between theoretical knowledge and practical application, suggesting a need to explore the underlying reasons for

TABLE 5 Comparison of the nurses' medical device-related pressure injuries experiences with their Medical Device-related Pressure Injuries Knowledge and Practice Assessment Tool scores.

Variable	Total scale Mean (SD)	Aetiology/risk factors Mean (SD)	Prevention interventions Mean (SD)	Staging Mean (SD)
Do you encounter MDRPIs in your unit?				
Yes	11.42 (2.53)	4.40 (1.39)	4.09 (1.36)	2.92 (1.16)
No	10.27 (2.71)	4.08 (1.68)	3.37 (1.40)	2.81 (1.02)
Test and <i>p</i> -value	$t = 2.342; p = 0.021^*$	$t = 1.150; p = 0.252$	$t = 2.731; p = 0.007^*$	$t = 0.528; p = 0.598$
Do you feel responsible for the development of MDRPIs?				
Yes	11.47 (2.46)	4.49 (1.38)	4.04 (1.34)	2.94 (1.14)
No	10.11 (2.85)	3.83 (1.66)	3.53 (1.54)	2.75 (1.08)
Test and <i>p</i> -value	$t = -2.746; p = 0.007^*$	$t = -2.323; p = 0.022^*$	$t = -1.901; p = 0.059$	$t = -0.895; p = 0.372$
Do you believe that MDRPIs can be prevented with nursing care?				
Yes	11.37 (2.47)	4.45 (1.40)	4.01 (1.36)	2.92 (1.15)
No	11.27 (3.29)	4.09 (2.02)	4.00 (1.48)	3.18 (0.75)
Not sure	10.00 (2.77)	3.88 (1.54)	3.44 (1.53)	2.68 (1.14)
Test and <i>p</i> -value	$F = 2.876; p = 0.060$	$F = 1.655; p = 0.195$	$F = 1.709; p = 0.185$	$F = 0.832; p = 0.437$
Have you received any training on MDRPIs?				
Yes	11.20 (2.92)	4.34 (1.60)	4.00 (1.48)	2.86 (1.18)
No	11.08 (2.43)	4.31 (1.41)	3.85 (1.36)	2.92 (1.09)
Test and <i>p</i> -value	$t = 0.257; p = 0.797$	$t = 0.114; p = 0.910$	$t = 0.620; p = 0.536$	$t = -0.323; p = 0.747$
Do you believe that your knowledge of MDRPIs is sufficient?				
Yes	11.21 (2.72)	4.46 (1.43)	3.92 (1.51)	2.83 (0.98)
No	11.08 (2.58)	4.24 (1.51)	3.90 (1.35)	2.93 (1.20)
Test and <i>p</i> -value	$t = 0.294; p = 0.796$	$t = 0.853; p = 0.395$	$t = 0.090; p = 0.929$	$t = 0.547; p = 0.585$
Would you like to attend a training on MDRPIs?				
Yes	11.32 (2.42)	4.38 (1.40)	4.02 (1.35)	2.92 (1.12)
No	9.36 (3.69)	3.79 (2.04)	2.93 (1.54)	2.64 (1.15)
Test and <i>p</i> -value	$t = 1.942; p = 0.072$	$t = 1.060; p = 0.306$	$t = 2.818; p = 0.006^*$	$t = 0.883; p = 0.379$

Note: Bonferroni correction was applied in the comparison of groups.

Abbreviations: *F*, One-Way ANOVA; MDRPIs, medical device-related pressure injuries; SD, standard deviation; *t*, Independent Samples *t*-test.

* $p < 0.05$.

this discrepancy. To prevent the occurrence of MDRPIs in intensive care patients, nurses are expected to identify risk factors early and intervene promptly.¹¹ However, our findings suggest that nurses' knowledge and awareness of prevention interventions are inadequate.

The nurses in our study exhibited the lowest mean score in the Staging sub-scale of the measurement tool. Consistently with our findings, Sönmez and Bahar²³ reported that nurses have low scores in the 'Staging' sub-scale, while Fu et al.²⁴ observed low scores among nurses for the 'Concept and staging' sub-scale. The pressure exerted by medical devices (such as nasal cannula, endotracheal tubes, nasogastric/orogastric tubes, urinary catheters) placed on mucosal tissues can lead to PIs in these tissues. In a prospective observational study investigating

the characteristics of MDRPIs among adult intensive care patients, it was found that MDRPIs occurred more frequently in the mucous membranes (34.2%) and as a result, they recommended that mucosal assessment be included as part of skin assessments when medical devices are used.¹⁵ The International NPUAP/EPUAP/PPPIA Pressure Ulcer Classification System is not utilized for staging mucosal PIs.³ The nurses' low scores in the staging sub-scale may have resulted from their lack of knowledge on this subject.

Of the nurses, 74.8% feel responsible for the occurrence of MDRPIs and 74.8% believe that MDRPIs can be prevented with a good level of nursing care. In a qualitative study conducted by Tan et al.,³² all nurses identified the prevention of MDRPIs as a nursing responsibility.

However, the nurses stated that MDRPIs are inevitable, especially in critically ill patients, and despite being aware of MDRPIs, their inability to prevent the occurrence of MDRPIs made them feel guilty.³² It is desirable that the majority of nurses are aware that MDRPIs can be prevented with nursing care and that they feel responsible for addressing this issue. However, considering specific factors such as the appropriateness, necessity and safety of medical devices, as well as institutional resources and strategies, the prevention of MDRPIs requires communication and collaboration among all healthcare providers, not just nurses.^{19,33}

In this study, it was found that the knowledge and practice levels of nurses did not differ significantly based on their education level and years of professional service. However, nurses with bachelor's and postgraduate degrees scored higher on the MDPI-ASSET total scale than those with other educational backgrounds. Another study identified that nurses' level of education is a predictor of their knowledge, attitudes and practices regarding MDRPIs.²⁸ Consistently, a previous study reported that the knowledge and practice scores of nurses with a bachelor's degree or higher education were greater than those of other nurses, and the practice scores increased as the work experience of the nurses in the ICU increased.²⁹ Consistent with the literature, nurses with 11 or more years of ICU experience scored higher on the MDPI-ASSET total scale compared to those with less ICU experience. ICUs are specialized units where patients with life-threatening and potentially critical conditions are monitored, and complex advanced technologies are utilized. Therefore, intensive care nurses must be competent to meet the monitoring, treatment and care needs of critically ill patients.³⁴ It is believed that the duration of experience in the ICU plays a significant role in the development of nurses' competencies related to critical patient care. Additionally, nurses with more experience in the ICU may have greater awareness due to their increased exposure to PIs. It can be argued that this experience is reflected in nurses' knowledge and practices regarding MDRPIs, which is a common issue in ICUs.

It was found that nurses with 21 or more years of professional experience had lower scores than those with less professional experience. In the 2016 consensus by the National Pressure Ulcer Advisory Panel, the definition and staging of PIs were updated and expanded to include 'medical and other types of devices'.³⁵ Since MDRPI is a relatively new concept, it is possible that this topic was not thoroughly covered in the formal education curricula of nurses who graduated some time ago. We believe that the lower MDPI-ASSET scores observed in nurses with 21 or more years of professional experience compared to those with less experience may be related to this gap in

their education. This finding suggests that MDRPIs should be incorporated into the in-service training programmes for nurses.

It was determined that the knowledge and practice levels of the nurses differed significantly depending on their previous encounters with MDRPIs and their feelings of responsibility for the development of MDRPIs. Consistent with our findings, a previous study reported that one of the factors affecting nurses' level of knowledge is the frequency of encountering MDRPIs.²³ These results suggest that nurses who frequently encounter MDRPIs may increase their knowledge levels through experiential learning.

The study revealed that nurses who received training on MDRPIs exhibited higher knowledge and practice scores compared to those who did not receive such training. However, this difference was not statistically significant. Previous studies on this subject reported that the level of knowledge among nurses regarding MDRPIs was significantly influenced by both the receipt of training and the duration since the training received.^{23,24} Nurses were not asked about the specifics of when, where or how they received training on MDRPIs. They were only asked whether they had received any training. The lack of a significant difference between the scale scores of those who had received MDRPI training and those who had not may be attributed to factors such as the passage of time since the training, the absence of repeated training and the use of inadequate equipment. Consequently, this finding suggests that nurses should receive repeated training with updated information on MDRPIs and the use of appropriate equipment. Considering the important role of nurses in the prevention of MDRPIs, enhancing nurses' development through continuous training can ensure the effective implementation of preventive strategies. Otherwise, the task of reducing the prevalence and incidence of MDRPIs in the ICU may become challenging or even unattainable.

4.1 | Limitations of the study

This study was carried out in three different provinces of Türkiye with a small sample size. Consequently, the data obtained from the study cannot be generalized to all intensive care nurses. The Cronbach's alpha internal consistency coefficient of the measurement tool calculated in this study was quite low. This presents another limitation of the study. The knowledge and practices of nurses regarding MDRPIs were collected using a single self-report instrument, without any additional objective observations. Furthermore, as no qualitative data were gathered, the findings do not offer an in-depth

examination of the factors influencing nurses' knowledge and practices related to MDRPIs.

5 | CONCLUSION

ICUs are settings where MDRPIs are frequently observed. This highlights the necessity for nurses to have knowledge of MDRPIs and to implement evidence-based preventive practices. Our findings revealed that the knowledge and practices of nurses regarding MDRPIs were not adequate. Based on the findings of this study, the authors recommend that intensive care nurses should be supported with continuous and practical training on MDRPIs to ensure the provision of safe and qualified care. Additionally, organizational administrators should identify gaps and needs regarding MDRPIs and develop appropriate strategies accordingly.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data available on request due to privacy/ethical restrictions.

ETHICS STATEMENT

Ethics committee approval was obtained from the Amasya University Non-Interventional Clinical Research Ethics Committee (7 September 2023/No: 2023/107).

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