

## ORIGINAL ARTICLE

# Medical device-related pressure ulcer (MDRPU) in acute care hospitals and its perceived importance and prevention performance by clinical nurses

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The incidence rate of patients developing pressure ulcers associated with medical device use is underreported in Korea. This study aims to determine clinical nurses' perceived importance and performance towards medical device-related pressure injury prevention. A total of 620 nurses from seven hospitals attending continuing education programmes in Korea responded to self-administered questionnaires. Data were collected from March to December 2017 on a 4-point-Likert scale on nurses' perceived importance and performance for prevention of medical device-related pressure ulcer (MDRPU). Secondary data analysis was performed through reported pressure injury incidence, and questionnaire data were analysed using descriptive statistics, *t*-test, and ANOVA. The overall rates of hospital-acquired pressure ulcers and MDRPU were 16.9% and 0.8%, respectively. The proportion of MDRPU was 5.02%. Its perceived importance ( $3.56 \pm 0.48$ ) was also higher than prevention performance ( $3.13 \pm 0.90$ ) among nurses. Education level and participation in pressure injury management training was found to enhance prevention performance by nurses. Therefore, informational and educational programmes based on clinical practice are necessary for clinical nurses to focus on perceived importance and performance towards prevention of medical device-related pressure injury and pressure ulcer care.

## KEYWORDS

medical devices, nurses, pressure ulcer, prevention

## 1 | INTRODUCTION

Pressure ulcer refers to a localised injury to the skin or underlying tissue from sustained pressure and pressure associated with shear force. It usually occurs in areas with protruding bone and is associated with many contributing or confounding factors, but the primary cause is known to be impaired physical mobility.<sup>1</sup> Pressure ulcer, together with an existing disease, may cause deterioration of health, which can lead to further complications such as infection as well as extended hospitalisation and rehabilitation, resulting in an increase in unnecessary medical expenditure because of treatments and tests. Moreover, if left untreated, it can also increase the risk of death.<sup>2</sup> Accordingly, as pressure ulcers gradually gained recognition as a global patient safety issue,

hospitals began making significant efforts to reduce pressure ulcers that develop after admission.<sup>3</sup> Especially in nursing, despite investing in medical costs and implementing various practical efforts for prevention of pressure ulcers as one of the activities of safety nursing, pressure ulcers continue to occur and remain a major issue in medicine.

The incidence rate of pressure ulcers in intensive care unit (ICU) patients was reported to be 53.4%,<sup>4</sup> while the incidence rate among elderly and paediatric patients was reported to be 59% and 27%, respectively.<sup>5,6</sup> In Korea, pressure ulcers remain a major issue, with a high incidence of 23.7% in ICU patients,<sup>7</sup> 65.5% in elderly patients aged 65 years or older, and 18.8% in paediatric patients.<sup>8,9</sup> One such pressure ulcer is medical device-related pressure ulcer (MDRPU), which is receiving significant attention in recent

times for its hospital-acquired rate; it develops with the use of products with diagnostic or therapeutic applications.<sup>1</sup> MDRPU can be caused by the use of respiratory and orthopaedic devices, urinary catheters, faecal incontinence management devices, surgical drainage devices, central venous catheters, dialysis catheters, intermittent pneumatic devices, compression stockings, restraining devices, and drainage tubes.

Among the hospital-acquired pressure ulcers (HAPUs), MDRPUs refer to pressure ulcers that develop from using medical devices for diagnostic or therapeutic purposes, which usually include nasal cannula, nasogastric tube, plaster bandage, splint, intubation tube, mask, naso-tracheal tube, neck brace, pulse oximeter, percutaneous pulse oximeter probe, electrocardiogram electrode, and arteriovenous catheter.<sup>10</sup> Such pressure ulcers are usually affected by the following factors: device material being too hard, wrong choice of medical device, attaching the medical device on an area with little fat tissue, moisture condition of the skin where the device is attached, improper fixation method, improper use of adhesive tape, using many types of medical devices, using medical device on the same area for a long period, and overall condition of the patient.<sup>11,12</sup> Common sites of pressure ulcers include not only areas with protruding bone, which is a familiar issue, but also other areas where medical devices are often used. Therefore, it is necessary for nurses to assess not only areas with protruding bone where pressure ulcers commonly develop but also the skin area where the medical devices are attached. However, the incidence of an MDRPU varies depending on inpatient characteristics and medical devices applied. Moreover, an MDRPU is not detected early in many cases because of (a) lack of awareness among nurses, (b) concerns about lifting or repositioning the medical device or the fixed medical device coming loose during assessment, and (c) the need for consent or cooperation from a doctor.<sup>6</sup> Application of a medical device itself does not always cause pressure ulcers, but pressure ulcers are related to the use of such medical devices if the medical device is not applied properly, its position is not changed often enough, or the device is not fixed properly; a poorly fitting medical device is used, or an inappropriate device is fitted.<sup>13</sup> Patient-related risk factors include sensory impairment, dampness beneath the medical device, problematic perfusion and tissue durability, malnutrition, and oedema. It may occur in all patients, including small children.<sup>14</sup> As mentioned earlier, although pressure ulcers often develop in areas with protruding bone, an MDRPU can develop in all areas where a medical device is applied, as well as in the mucosa membrane within a body cavity that leads to the outside, such as the tongue, intraoral mucosa, vagina, urethra, trachea, and nasal cavity.<sup>11</sup> According to Pittman et al,<sup>3</sup> 50% of HAPUs are related to medical device use, while Van Gilder et al<sup>4</sup> reported that 11.9% of pressure ulcers are MDRPUs. The prevalence of such an MDRPU is

#### Key Messages

- this descriptive study aimed to determine clinical nurses' perceived importance and performance towards preventing medical device-related pressure injury
- the overall rate of hospital-acquired pressure ulcers and medical device-related pressure ulcer (MDRPU) was 16.9% and 0.8%, respectively; the proportion of MDRPU was 5.02%
- educational programmes, including MDRPUs based on clinical practice, are required for nurses to improve perceived importance and performance towards preventing MDRPUs

8.3% to 9.7%,<sup>12</sup> while the cause of pressure ulcers in 11.9% to 50% of cases is attributable to use of a medical device.<sup>3,4,15</sup> Therefore, strategies for accurately assessing and actively preventing MDRPUs are needed. Because MDRPU is preventable if the causes are clearly identified and pre-emptive measures are taken, the perceived importance of MDRPU (PI-MDRPU) prevention and prevention performance of MDRPU (PP-MDRPU) prevention measures among medical staff are crucial. In particular, ICU, elderly, and paediatric patients need to be recognised as high-risk groups that require closer attention.<sup>1</sup> Therefore, there is a need to develop education that includes MDRPU and its assessment; accordingly, the present study investigated the current incidence rates of MDRPU and the perceived importance and performance of MDRPU prevention activities by nurses to gather basic data for developing nursing strategies and practical application of effective pressure ulcer prevention.

### 1.1 | Objectives

The objective of the present study is to identify the current state of MDRPUs occurring in health care institutions in Korea and the level of PI-MDRPU and PP-MDRPU among clinical nurses. Specific goals were as follows:

1. Identify the incidence rate of MDRPUs in health care institutions, cause of MDRPUs, and most common sites of MDRPUs.
2. Identify the level of PI-MDRPUs and PP-MDRPU prevention among clinical nurses.

## 2 | METHODS

### 2.1 | Research design

This study used a descriptive survey design to identify the current state of MDRPUs occurring in a health care institutions in Korea and the level of perception and preventive care performance of nurses.

## 2.2 | Subjects

The present study investigated the incidence rate of MDRPU between January and December 2016 in five health care institutions in Korea with at least 500 beds, along with the causes of MDRPU and the site of MDRPU in 227 cases.

To understand PI-MDRPU and PP-MDRPUs, questionnaires were distributed to 682 nurses who consented to participate in the study from among nurses who attended the first academic conference and fourth continuing education seminar held by the Korean Association of Wound Ostomy Continence Nurses (KAWOCN) in 2017. Incomplete questionnaires from 62 nurses were excluded from data analysis. Missing responses were excluded, and only the questions that had been answered were analysed.

## 2.3 | Research tools

### 2.3.1 | Incidence rate of pressure ulcer and MDRPU

*Incidence rate of pressure ulcer (incidence rate of HAPU):* The incidence rate of pressure ulcer is a measure of the number of cases of pressure ulcers that newly developed after hospitalisation, using the rate of pressure ulcers per 1000 days of hospitalisation. This is an indicator management method developed by the Korea Institute for Healthcare Accreditation, where—because the duration of exposure to the risk of pressure ulcer is different for each individual—the number of days of hospitalisation representing the actual duration of exposure to the risk of pressure ulcer is calculated and used as the denominator. Pressure ulcers at the time of admission are excluded from the numerator, and each incidence of a newly developed pressure ulcer in the same patient was added to the numerator.

$$\text{Incidence rate of pressure ulcers} = \frac{\text{Number of newly developed pressure ulcers after hospitalization}}{\text{Number of days of hospitalization}} \times 1000,$$

where number of days of hospitalisation is the sum of days of hospitalisation of inpatients over a specific period.

*Incidence rate of MDRPUs:* To calculate the incidence rate of MDRPUs, the number of newly developed MDRPUs was measured using the same method as that used to calculate the incidence rate of HAPUs. The present study used the number of newly developed MDRPUs per 1000 days of hospitalisation as the incidence rate of MDRPUs.

$$\text{Incidence rate of MDRPU} = \frac{\text{Number of newly developed MDRPUs after hospitalization}}{\text{Number of days of hospitalization}} \times 1000,$$

where number of days of hospitalisation is the sum of days of hospitalisation of inpatients over a specific period.

## 2.4 | Instruments: PI-MDRPU and PP-MDRPU

The tools for assessing PI-MDRPU and PP-MDRPU contained nursing assessment content according to the classification of causes of MDRPUs, performance of preventive activities, records and reports, and education. These tools were developed by the researcher based on literature review. Specifically, the items were related to assistive devices (brace, neck collar, cast, and splint), anti-embolic devices (anti-embolic stocking), intermittent pneumatic compression (ICP) devices, various catheters (arterial catheter, haemodialysis catheter, and extracorporeal membrane oxygenation [ECMO] catheter), restraints, oxygen supply devices (oxygen mask, nasal cannula, and tracheostomy tube), and patient-monitoring devices (electrocardiogram and pulse oximeter probe). Each item was scored on a 4-point Likert scale, with higher scores indicating a higher level of PI-MDRPU and P-MDRPU. The reliability of the PI-MDRPU and P-MDRPU tools used in the present study showed Cronbach's  $\alpha$  of 0.954 and 0.925, respectively.

## 2.5 | Data analysis method

Causes, stages, and common sites of MDRPU were analysed as percentages and frequencies, while PI-MDRPU and PP-MDRPU, according to the general characteristics of the subjects, were analysed using *t*-test and ANOVA.

## 2.6 | Ethical consideration

The present study was approved by the relevant institutional review board (No. 2016-1029). After receiving

an explanation on the objective and content of the study, those who voluntarily consented to participate in the study were selected. Ethical consideration was given by notifying the participants that their responses will not be used for purposes other than this study; their privacy will be protected; and responses to the questionnaire will be destroyed upon completion of the study. The participants provided their responses to the

questionnaire after signing the written informed consent form.

### 3 | RESULTS

#### 3.1 | Current state of MDRPU

##### 3.1.1 | Incidence rate of pressure ulcer and MDRPU

In the present study, the incidence rate of pressure ulcers and MDRPUs in 2016 was 1.69 and 0.09 cases (%) per 1000 days of hospitalisation, respectively. Of all pressure ulcers, MDRPUs accounted for 5.48%.

##### 3.1.2 | Analysis of distribution of MDRPU by stages and causes

The distribution of MDRPUs for stages 1, 2, 3, and 4 was 28.6%, 34.8%, 4.4%, and 0.9%, respectively, while suspected deep tissue injury and unclassified were 26.9% and 4.4%, respectively (Table 1). The distribution of MDRPUs by site was 6.2% for ear, 8.8% for forehead (including head), 5.3% for the cheek, 32.6% for nose, 3.5% for mouth, 3.1% for neck (including chest), 14.1% for legs, 5.3% for heels, 4.0% for toes, 8.8% for arms, 4.4% for hand (including fingers), 1.3% for back, and 2.6% for buttocks (Table 2).

The causes of MDRPUs included wearing neurosurgical assistive devices, including brace and neck collar (7.5%); wearing orthopaedic assistive devices, including splint and cast (6.6%); wearing anti-embolic stocking and sequential compression device (22.5%); Intravenous and arterial catheterisation (5.3%); Foley catheterisation (1.8%); nasogastric intubation (17.6%); oxygen saturation measurement for patient monitoring (7.0%); use of nasal cannula (11.9%); non-invasive ventilation masks such as positive pressure respirator (15.9%); and endotracheal intubation, including the use of naso-tracheal and endo-tracheal tube (4.0%) (Table 3).

#### 3.2 | PI-MDRPU and PP-MDRPU of clinical nurses

##### 3.2.1 | General characteristics of respondents

The mean age of the subjects was 31.3 years, and 64.5% were graduates from 4-year nursing colleges. With respect to job title, 73.5% were general nurses, and 5.2% were nurse practitioners. The mean clinical experience of the nurses was 7.3 years.

For assigned departments, the responses included surgery (30.2%), internal medicine (22.9%), and ICU (28.7%),

**TABLE 1** Distribution of medical device-related pressure ulcer (MDRPU) by stages ( $N = 227$ )

Category	Type	<i>n</i> (%)
Pressure ulcer classification	Stage 1	65 (28.6)
	Stage 2	79 (34.8)
	Stage 3	10 (4.4)
	Stage 4	2 (0.9)
	Suspected deep tissue injury	61 (26.9)
	Unstageable	10 (4.4)

**TABLE 2** Distribution of medical device-related pressure ulcer (MDRPU) by sites ( $N = 227$ )

Categories	Type	<i>n</i> (%)
Site	Ears	14 (6.2)
	Cheeks	12 (5.3)
	Forehead (including head)	20 (8.8)
	Neck (including chest)	7 (3.1)
	Nose	74 (32.6)
	Mouth	8 (3.5)
	Legs (including thighs)	32 (14.1)
	Heels	12 (5.3)
	Toes	9 (4.0)
	Back	3 (1.3)
	Buttocks	6 (2.6)
	Arms	20 (8.8)
	Hands (including fingers)	10 (4.4)

while most of the subjects worked in large hospitals with 500 to 999 beds (57.1%) and  $\geq 1000$  beds (22.1%).

For the frequency of pressure ulcer-related training within 1 year, the most common response was one to two times with 51.0%, while no training was 21.3%. Meanwhile, 66.6% had MDRPU nursing experience, and the mean frequency of MDRPU nursing per month was 2.5 times (Table 4).

##### 3.2.2 | Subject characteristics related to MDRPU nursing

Participants reported that, among the causes of MDRPU, use of a cast, splint, anti-embolic stocking, and IPC was 35%, 26%, 33.2%, and 12.7%, respectively. For catheters inserted into the body, Foley catheter, arterial catheter inserted for blood pressure monitoring in ICU, ECMO, and haemodialysis catheter accounted for 26.1%, 11.5%, 10.2%, and 5.8%, respectively. Probes used for oxygen saturation measurement and EEG accounted for 18.5% and 1.8%, respectively, while among medical devices used to supply oxygen, nasal cannula showed the highest frequency of 53.7%, followed in

**TABLE 3** Causes of medical device-related pressure ulcer (MDRPU) ( $N = 227$ )

Category	Type	<i>n</i> (%)
Assistive devices	Neurosurgical assistive devices (brace and neck collar)	17 (7.5)
	Orthopaedic assistive devices (cast and splint)	15 (6.6)
Embolism prevention devices	Anti-embolic stocking and intermittent pneumatic compression (IPC)	51 (22.5)
Catheters	IV and arterial catheter	12 (5.3)
	Foley catheterisation	4 (1.8)
	Nasogastric catheterisation	40 (17.6)
Monitoring devices	Pulse oximeter probe	16 (7.0)
Oxygen supply devices	Nasal cannula	27 (11.9)
	Non-invasive ventilation masks	36 (15.9)
	Endotracheal intubation (naso-tracheal and endo-tracheal tube)	9 (4.0)



**TABLE 4** General characteristics ( $N = 620$ )

Category		n (%) or M $\pm$ SD
Age (y)		31.3 $\pm$ 7.6
Education level <sup>a</sup>	Diploma	141 (21.5)
	Bachelor	400 (61.3)
	$\geq$ Master	77 (17.2)
Job title <sup>a</sup>	General nurse	456 (73.7)
	Charge nurse	80 (12.9)
	Head nurse	48 (7.8)
	Nurse practitioner	32 (5.2)
	Others	2 (0.3)
Clinical experience (y) <sup>a</sup>	<5	302 (49.2)
	5 to 9	128 (21.2)
	$\geq$ 10	175 (28.5)
		7.3 $\pm$ 6.9
Assigned department <sup>a</sup>	Surgery	187 (30.4)
	Internal medicine	142 (23.1)
	ICU	178 (29.0)
	ER	2 (0.3)
	Others	105 (17.1)
Number of beds at the hospital <sup>a</sup>	$\geq$ 1000	137 (22.7)
	500 to 999	354 (58.7)
	200 to 499	89 (14.8)
	<200	23 (3.8)

ER, emergency room; ICU, intensive care unit.

<sup>a</sup> Excluded non-responses.

order by oxygen mask (19.4%), endo-tracheal tube (18.4%), and naso-tracheal tube (17.9%). In addition, use of a restraint was 39.2% (Table 5).

With respect to stages of MDRPU, the most common was stage 2 (32.9%), followed by stage 1 (31.3%). When MDRPUs occurred, 84.2% reported it, whereas 15.8% did not report the case. The reasons for not reporting such incidences included (a) because it was different from regular pressure ulcer (42%), (b) did not receive training about reporting (35%), (c) did not know it was a pressure ulcer (16.0%), and (d) because of busy work schedule (0.7%).

The percentage of those who responded that there is MDRPU prevention and treatment protocols at their hospitals were 49.5% and 40.3%, respectively, and in such cases, the percentage of those who performed prevention and treatment protocols was 47.4% and 37.1%, respectively.

### 3.3 | PI-MDRPU and PP-MDRPU by clinical nurses

The mean PI-MDRPU and P-MDRPU scores of clinical nurses was 3.56 ( $\pm$ 0.48) and 3.13 ( $\pm$ 0.90) points, respectively, indicating a higher score for PI-MDRPU and a relatively lower score for PP-MDRPU (see Table 6). Among these, the major items that showed the highest PI-MDRPU score was “When a restraint is used, I check the condition of the skin where it is applied every 2 hours” (3.71  $\pm$  0.50 points), but “I reposition the measuring device in patients who require continued oxygen saturation measurement”

showed a relatively low score of 3.38  $\pm$  0.67 points among the 17 items.

With respect to PP-MDRPU, the item that showed the highest score was “When caring for patients, I check at least once to make sure catheters (Foley catheter, drainage bag, or Percutaneous transhepatic biliary drainage), monitoring devices (EEG and pulse oximeter probe), arterial catheter, or needle cap are not misplaced under the body to cause skin injury” (3.51  $\pm$  0.73 points); however, “I reposition the measuring device in patients who require continued oxygen saturation measurement” and “I apply prophylactic dressing to prevent MDRPU” showed a very low score of 2.79  $\pm$  1.12 and 2.92  $\pm$  1.29 points, respectively.

### 3.4 | Comparisons of PI-MDRPU and PP-MDRPU

Education level and assigned departments of clinical nurses showed statistically significant differences in PI-MDRPU ( $P = 0.021/P < 0.001$ ) and PP-MDRPU ( $P < 0.001/P < 0.001$ ) scores.

PP-MDRPU was statistically significant only in job title ( $P = 0.008$ ), while P-MDRPU showed significant difference based on the number of hospital beds as well ( $P < 0.001$ ).

Higher frequency of participation in pressure ulcer-related training showed significant difference in PP-MDRPU ( $P = 0.016$ ); participation in MDRPU-related training did not show a difference in PP-MDRPU ( $P = 0.056$ ), but having participation experience showed a significant difference in PI-MDRPU ( $P = 0.001$ ). Frequency of MDRPU nursing and confidence in MDRPU prevention did not show significant differences in PI-MDRPU and PP-MDRPU.

For institutions with MDRPU prevention and treatment protocols, PI-MDRPU did not show a statistically significant difference, whereas PP-MDRPU showed a statistically significant difference ( $P = 0.008$ ) (Table 7).

## 4 | DISCUSSION

### 4.1 | Incidence rate of MDRPU

Among nursing quality indicators, MDRPU has been receiving much attention in recent times. As a result, its importance has increased significantly. In the International Clinical Practice Guidelines for pressure ulcer prevention and treatment developed by the US National Pressure Ulcer Advisory Board and the European Pressure Ulcer Advisory Board in 2009, only skin assessment methods, pressure redistribution, and skin protection were partially emphasised for MDRPUs. The guidelines developed in 2014 were expanded to include participation by Asian pressure ulcer committees, and MDRPU was newly presented as one of the topics chosen as an important part of nursing quality management for pressure ulcers. In

TABLE 5 Subject characteristics related to MDRPU nursing ( $N = 653$ )

Category		n (%) or $M \pm SD$	
Frequency of pressure ulcer related training <sup>a</sup>	None	132 (21.3)	
	1 to 2 times	316 (51.0)	
	3 to 4 times	105 (16.9)	
	$\geq 5$ times	66 (10.6)	
MDRPU training experience <sup>a</sup>	Yes	304 (49.0)	
	No	293 (47.3)	
MDRPU nursing experience <sup>a</sup>	Yes	413 (66.6)	
	No	198 (31.9)	
Mean frequency of MDRPU nursing per month <sup>a</sup>	None	9 (1.5)	
	$\leq 1$	98 (15.8)	
	2 to 5	57 (9.2)	
	6 to 10	8 (1.3)	
	$\geq 10$	9 (1.5)	
		$2.5 \pm 3.9$	
Cause of MDRPU <sup>a</sup>	Assistive devices	Brace	89 (14.4)
		Neck collar	95 (15.3)
		Cast	217 (35)
		Splint	161 (26)
	Anti-embolic devices	Anti-embolic stocking	206 (33.2)
		Intermittent pneumatic compression	79 (12.7)
	Catheters	Arterial catheter	71 (11.5)
		Hemodialysis catheter	36 (5.8)
		ECMO catheter	63 (10.2)
		Foley catheter	162 (26.1)
	Monitoring devices	Pulse oximeter probe	115 (18.5)
		EEG probe	11 (1.8)
	Oxygen supply devices	Nasal cannula	333 (53.7)
		Oxygen mask	120 (19.4)
		Endotracheal tube	114 (18.4)
Naso-tracheal tube		111 (17.9)	
	Restraints	243 (39.2)	
Classification of common MDRPUs <sup>a</sup>	Stage 1	193 (31.3)	
	Stage 2	204 (32.9)	
	Stage 3	8 (1.3)	
	Stage 4	3 (0.5)	
	Suspected deep tissue injury	22 (3.5)	
	Unstageable	8 (1.3)	
MDRPU reporting <sup>a</sup>	Yes	480 (84.2)	
	No	90 (15.8)	
Reason for not reporting MDRPU <sup>a</sup>	Did not know it was a pressure ulcer	21 (16)	
	Believed it was different than regular pressure ulcer	55 (42)	
	Did not receive training on reporting	45 (35)	
	Knew it needed to be reported, but was too busy	9 (0.7)	
MDRPU prevention protocol <sup>a</sup>	Yes	307 (49.5)	
	No	290 (46.8)	
Performance of MDRPU prevention protocol <sup>a</sup>	Yes	294 (47.4)	
	No	14 (2.3)	
MDRPU treatment protocol <sup>a</sup>	Yes	205 (40.3)	
	No	290 (46.8)	
Performance of MDRPU treatment protocol <sup>a</sup>	Yes	230 (37.1)	
	No	12 (1.9)	

ECMO, extracorporeal membrane oxygenation; EEG, electroencephalography; MDRPU, medical device-related pressure ulcer.

<sup>a</sup> Excluded non-responses.

**TABLE 6** PI-MDRPU and PP-MDRPU scores of clinical nurses ( $N = 620$ )

Item	M ± SD	
	PI-MDRPU	PP-MDRPU
1. I check the condition of the skin underneath the medical device at least once.	3.57 ± 0.57	3.22 ± 0.84
2. I reposition the measuring device in patients who require continued oxygen saturation measurement.	3.38 ± 0.67	2.79 ± 1.12
3. When a restraint is used, I check the condition of the skin where it is applied every 2 h.	3.71 ± 0.50	2.97 ± 1.30
4. Every day, I check the perineal region and surrounding skin of patients who have a Foley catheter.	3.55 ± 0.59	3.36 ± 0.84
5. I check the condition of the skin around the endotracheal tube.	3.65 ± 0.54	3.48 ± 0.73
6. For patients who maintain an endotracheal tube, I check the condition of the skin underneath the line around the neck.	3.61 ± 0.55	3.23 ± 0.80
7. I check the condition of the skin underneath the catheter (arterial, hemodialysis, and ECMO catheter).	3.61 ± 0.55	3.29 ± 0.80
8. I check the condition of the skin around the face, ears, and under the nose of patients who use an oxygen mask or a cannula.	3.59 ± 0.56	3.38 ± 0.74
9. I check the condition of the skin around the feet, thighs, and calves when applying anti-embolic stockings or intermittent pneumatic compression (IPC).	3.53 ± 0.59	3.14 ± 0.84
10. I check the skin condition of patients who have a brace, neck collar, cast, or splint.	3.57 ± 0.56	3.18 ± 0.81
11. I apply prophylactic dressing to prevent MDRPU.	3.54 ± 0.60	2.92 ± 1.29
12. I train colleague nurses or caregivers about regularly checking the skin condition for prevention of MDRPU.	3.64 ± 0.56	3.01 ± 1.24
13. I report any discovery of MDRPU.	3.64 ± 0.55	3.01 ± 1.35
14. When classifying MDRPU, I use the same staging as regular pressure ulcers.	3.58 ± 0.59	3.26 ± 0.96
15. Whenever I discover MDRPU, I record and monitor it just like a regular pressure ulcer.	3.62 ± 0.56	3.38 ± 0.88
16. I monitor patients who are susceptible to MDRPU (edema, elderly, pediatric, and ICU patients).	3.68 ± 0.51	3.39 ± 0.80
17. When caring for patients, I check at least once to make sure catheters (Foley catheter, drainage bag, or PTBD), monitoring devices (EEG and pulse oximeter probe), arterial catheter, or needle cap are not misplaced under the body to cause skin injury.	3.69 ± 0.50	3.51 ± 0.73
Overall	3.56 ± 0.48	3.13 ± 0.90

ECMO, extracorporeal membrane oxygenation; EEG, electroencephalography; MDRPU, medical device-related pressure ulcer.

addition, the definition of pressure ulcer provided by the National Pressure Ulcer Advisory Board in 2016 included content about MDRPUs, heightening worldwide interest in MDRPU.

In the present study, the incidence rate of pressure ulcers per 1000 days of hospitalisation was 1.69 cases (‰), while

the incidence rate of MDRPUs was 0.09 cases (‰), accounting for 5.48% of all pressure ulcers. The results indicated significant increase compared with MDRPUs, accounting for 1.97% of all pressure ulcers in a study by Lee and Kim<sup>16</sup>. In the secondary analysis of prevalence of pressure ulcers by Black et al, the incidence rate of MDRPUs was 1.4%, while the incidence rate of MDRPUs in the ICU was reported to be 34.5%.<sup>12</sup> While an accurate comparison may be difficult because of differences in the calculation method, it can be determined that the incidence of MDRPUs is relatively lower. This may be because of a lack of accurate reporting of MDRPUs, as well as the awareness and importance of MDRPU being neglected by the medical staff, which requires further studies.

Based on the classification system for MDRPU, the rates of stage 1, 2, 3, and 4 pressure ulcers were 28.6%, 34.8%, 4.4%, and 0.9%, respectively, while suspected deep tissue injury stage and unstageable were 26.9% and 4.4%, respectively, which were similar to the results from a previous study.<sup>16</sup> However, distribution by confirmed pressure ulcer stages showed differences for stage 1 (31.3%), stage 2 (32.9%), and suspected deep tissue injury stage (3.5%), with suspected deep tissue injury stage showing a large difference. While incidences of MDRPUs are usually assessed by wound specialists, studies with assessment by general nurses may have confused suspected deep tissue injury stage as stage 1 or 2 pressure ulcer, and thus, further studies on this are needed. Moreover, according to another report, over 80% of MDRPUs were stage 1 pressure ulcers, although this study was conducted in the paediatric ICU.<sup>17</sup> However, the present study found higher incidence rates of stage 2 or suspected deep tissue injury than stage 1 pressure ulcers, which may have been because of pressure ulcers not being detected in the early stage and being reported at a later stage, after it has progressed. Such findings indicate the need for knowledge building and improved awareness about MDRPUs among nurses.

With respect to common sites of MDRPU, the nose (32.6%) and legs, including thighs (14.1%), showed high rates, which was similar to previously reported study results.<sup>4</sup> In particular, the incidence rate on thighs was four times higher than the rate reported by Black et al,<sup>12</sup> suggesting the need for management of this area. This was also similar to the results from a study by Lee and Kim,<sup>16</sup> in which anti-embolic stockings accounted for a high percentage of MDRPUs. Such findings confirmed the need for assessment and continued monitoring of surgical patients wearing stockings and applying stockings to patients to control leg oedema, as well as management of this issue. Moreover, training is also needed on the management and identification of pressure ulcer risk in the nose area through observations and preventive nursing of areas where nasogastric tubes are inserted.

**TABLE 7** Comparisons of perceived importance of MDRPU (PI-MDRPU) and prevention performance of MDRPU (PP-MDRPU) of clinical nurses ( $N = 620$ )

Category	<i>n</i> (%)	PI-MDRPU			PP-MDRPU			
		<i>M</i> ± <i>SD</i>	<i>F/t</i>	<i>P</i>	<i>M</i> ± <i>SD</i>	<i>F/t</i>	<i>P</i>	
Education level <sup>a</sup>	Associate degree	141 (22.7)	2.85 ± 1.58	3.89	0.021	2.86 ± 1.09	7.93	<0.001
	BSN	400 (64.5)	3.18 ± 1.57			3.20 ± 0.81		
	MSN or higher	77 (12.5)	3.23 ± 1.68			3.19 ± 1.01		
Job title <sup>a</sup>	General nurses	456 (73.5)	3.12 ± 1.23	1.3	0.257	3.09 ± 0.93	3.45	0.008
	Charge nurse	80 (12.9)	3.29 ± 1.17			3.42 ± 0.70		
	Head nurse	48 (7.7)	2.77 ± 1.64			2.93 ± 0.89		
	Nurse practitioner	32 (5.2)	3.09 ± 1.42			3.28 ± 0.67		
	Others	2 (0.3)	3.43 ± 0.40			3.70 ± 1.17		
Clinical experience (y) <sup>a</sup>	<5	302 (48.7)	3.15 ± 1.17	0.12	0.886	3.10 ± 0.89	0.61	0.546
	5 to 9	128 (20.6)	3.09 ± 1.28			3.15 ± 0.91		
	≥10	175 (28.2)	3.10 ± 1.39			3.19 ± 0.88		
Assigned department <sup>a</sup>	Surgery	187 (30.2)	3.09 ± 1.25	8.14	<0.001	3.09 ± 0.87	13.06	<0.001
	Internal medicine	142 (22.9)	2.92 ± 1.42			3.15 ± 0.86		
	ICU	178 (28.7)	3.47 ± 0.82			3.39 ± 0.59		
	Others	102 (16.9)	2.81 ± 1.53			2.72 ± 1.25		
Number of beds at the hospital <sup>a</sup>	≥1000	137 (22.1)	3.13 ± 1.27	1.55	0.214	3.10 ± 0.92	11.94	<0.001
	500–999	354 (57.1)	3.17 ± 1.19			3.26 ± 0.75		
	<500	112 (18.1)	2.93 ± 1.43			2.80 ± 1.13		
Frequency of MDRPU nursing <sup>a</sup>	None	9 (1.5)	2.80 ± 1.61			3.13 ± 1.20	0.78	0.506
	≤1	98 (15.8)	3.20 ± 1.26			3.18 ± 0.74		
	2 to 5	57 (9.2)	2.90 ± 1.41			2.98 ± 0.94		
	≥6	17 (2.8)	2.72 ± 1.60			2.97 ± 1.05		
Pressure ulcer training experience <sup>a</sup>	None	132 (21.3)	3.05 ± 0.35			2.92 ± 1.07	3.45	0.016
	1 to 2 times	316 (51.0)	3.06 ± 1.27			3.17 ± 0.83		
	3 to 4 times	105 (16.9)	3.20 ± 0.95			3.12 ± 0.95		
	≥5 times	66 (10.6)	3.35 ± 1.21			3.31 ± 0.74		
MDRPU training experience <sup>a</sup>	Yes	304 (49.0)	3.28 ± 1.13			3.19 ± 0.56	1.92	0.056
	No	293 (47.3)	2.94 ± 1.38			3.05 ± 0.95		
MDRPU prevention protocol <sup>a</sup>	Yes	307 (49.5)	3.27 ± 1.11			3.26 ± 0.77	2.34	0.019
	No	290 (46.8)	3.09 ± 1.26			3.11 ± 0.80		
MDRPU treatment protocol <sup>a</sup>	Yes	205 (40.3)	3.24 ± 1.19			3.30 ± 0.79	2.66	0.008
	No	290 (46.8)	3.16 ± 1.17			3.13 ± 0.76		

<sup>a</sup> Excluded non-responses.

## 4.2 | Assessment of PI-MDRPU and PP-MDRPU in clinical nurses

The clinical nurses who participated in the study demonstrated high PI-MDRPU score of  $3.56 \pm 0.48$  points, whereas the PP-MDRPU score was relatively lower at  $3.13 \pm 0.90$  points. The nurses showed high PI-MDRPU and PP-MDRPU scores for the assessment of skin conditions with regard to the use of EEG and pulse oximeter probes for monitoring patient conditions in clinical settings and use of drainage tubes and Foley catheter, whereas they showed a low score for regularly changing the applied area after a medical device is placed. In particular, checking the skin condition every 2 hours when using restraints showed high PI-MDRPU score of  $3.71 \pm 0.50$  points, but the P-MDRPU score for actual skin assessment showed the lowest score,

which suggested that there is a major difference between PI-MDRPU and PP-MDRPU in actual clinical settings.

Known risk factors of MDRPUs include sensory impairment, dampness beneath the medical device, poor perfusion, changes in tissue durability, malnutrition, and oedema.<sup>6,18,19</sup> The results in the present study showed that the PI-MDRPU score of nurses for high MDRPU risk groups was high, with  $3.68 \pm 0.51$  points, and PP-MDRPU score for assessing and monitoring such high-risk groups was also high, with  $3.39 \pm 0.80$  points. However, there are no studies that confirmed practical preventive nursing activities in relation to these, while follow-up studies are deemed necessary.

With respect to regularly changing the applied area after a medical device is placed, which showed a low PP-MDRPU score, the international clinical practice guidelines on



prevention and treatment of pressure ulcers strongly recommends that, for patients who require continuous oxygen saturation measurement, the skin condition should be checked at least twice to make sure there is no pressure injury in the site where the medical device is applied; in particular, if there are risk factors for localised or systemic oedema, skin assessment should be performed at least twice, and the measurement device should be repositioned on the ear or on another finger every 4 hours, when possible.<sup>1</sup> However, the findings in the present study showed that the PI-MDRPU and PP-MDRPU scores for checking skin conditions were high, but the scores for repositioning the device were relatively lower than other items. Therefore, there is a need for training to check that appropriately sized medical devices are being applied as instructed by the manufacturer's protocol and that the device is properly applied and fixed to the body without exerting additional pressure, as well as the need for monitoring to make sure these measures are being performed properly.

The knowledge and attitude of nurses about pressure ulcer management are very important contributing factors for effectively improving pressure ulcer prevention activities, that is, clinical practice guidelines for prevention. Despite such importance, studies on the knowledge and attitude of nurses about pressure ulcers and the compliance of effective performance based on such knowledge and attitude are still lacking.<sup>20</sup> According to a study by Yang and Moon, the importance and educational needs of pressure ulcer nursing were high, but the performance level was moderate.<sup>21</sup> Moreover, there were significant differences in performance levels based on the primary person responsible for pressure ulcer nursing education and pressure ulcer treatment and differences in perceived importance based on the primary person responsible for treatment. Such results were similar to the findings in this study.

The reasons for non-reporting of incidences of MDRPUs were analysed as the perception that an MDRPU is difficult to differentiate from a regular pressure ulcer and different protocols exist for MDRPU, lack of education, and busy schedule. It is believed that such results were because of previous studies being more focussed on overall pressure ulcer prevention activities and not specifically about MDRPU, and although a direct comparison is difficult as reporting of MDRPUs was not mentioned, the findings were similar to that of a study that reported lack of time, high severity of patients, and differences in work priorities as the impeding factors for pressure ulcer prevention activities.<sup>22</sup> Therefore, these results suggest the need for improved awareness and the educational need for MDRPU reporting.

Because MDRPUs increase with higher patient severity, providing high-quality nursing to prevent this can be viewed as an important aspect of nursing that can contribute significantly to decrease the overall incidence rate of pressure ulcers. However, actual study results showed that the

application of prophylactic dressing for the prevention of MDRPUs showed a high PI-MDRPU score of  $3.54 \pm 0.60$ , whereas the PP-MDRPU score was only  $2.92 \pm 1.29$  points, which indirectly demonstrated that prophylactic dressings for the prevention of pressure ulcers are not applied in clinical settings. According to studies on the prevention of MDRPUs, the incidence of pressure ulcers was effectively reduced by placing silicon foam dressing on the skin, underneath the area of the tracheotomy tube, and beneath the band that holds it to prevent skin injury.<sup>23</sup> Meanwhile, a study by Forni et al, which assessed the effects of applying foam dressing to the heels wrapped in plaster dressing for prevention of pressure ulcers, reported that doing so caused significant decrease in the incidence of pressure ulcers.<sup>24</sup> Moreover, it was reported that applying a gel sheet to the skin of premature infants receiving continuous positive airway pressure treatment was effective in preventing skin injuries, such as bleeding, skin tearing, and tissue necrosis.<sup>25</sup> Despite a greater body of evidence on prophylactic dressing than before and the need in evidence-based clinical nursing practice, systematic measures for actually performing it are lacking; it is being applied in a very unreasonable manner according to consumers who are receiving such a health care service, and thus, there is also the need for standards on coverage for preventive activities for patient groups at high risk of pressure ulcers.

The PI-MDRPU score for MDRPU reporting was high, whereas the PP-MDRPU score was low. This confirmed that there is a difference between perceived importance and prevention performance with respect to educating nurses and caregivers on the need for checking skin conditions for prevention of MDRPU and reporting and monitoring of pressure ulcers when they occur. Previous studies reported that the establishment of a support system for prevention and treatment, and related education, are of utmost importance in the prevention and treatment of pressure ulcers.<sup>26,27</sup> Therefore, accurate monitoring and recording by nurses, along with the application of quality improvement programmes in the clinical settings, to train medical staff to facilitate preventive activities and providing education and support for patients and caregivers through information sharing are needed for the prevention of MDRPUs.

The results of this study showed that experience in pressure ulcer-related training and a higher frequency of participation in MDRPU training resulted in increased PP-MDRPU scores. Among the participants, 78.5% responded that they have experience participating in pressure ulcer-related training, but participation in MDRPU training was only 49%, which suggested the need for additional MDRPU training. According to evidence-based clinical practice guidelines for the prevention and treatment of pressure ulcers, education at the institutional level and the need for developing regular educational policies to provide such education are recommended.<sup>1</sup> Moreover, because due consideration is needed for

the application of educational programmes and the assessment of learned outcomes, assessing the knowledge level of medical staff and the development and application of educational programmes that consider such details are needed in actual clinical settings to design education programmes and effectively deliver knowledge.

However, evidence that supports effective performance strategies of applying protocols for prevention of pressure ulcers is still weak, and thus, it is necessary to minimise the impediments of protocol application and assess the facilitators of effective performance.<sup>27</sup> As evidence supports this, studies have reported that the incidence and prevalence of pressure ulcers were reduced through the development of a recording system for high-risk patient monitoring, with participation by experts, such as certified wound ostomy continence nurses.<sup>28–30</sup>

It was reported that pressure ulcer reduction programmes developed through multidisciplinary expert panel meetings contributed to the reduction of incidence of pressure ulcers,<sup>31</sup> and thus, its application may be expanded for use as one of the strategies to reduce the incidence of MDRPU.

## 5 | CONCLUSIONS AND RECOMMENDATIONS

Among patient safety management quality indicators, pressure ulcer care is a very important aspect of nursing. There has been an increasing trend in the incidences of MDRPU, which has begun receiving attention lately. However, the reporting rate on this is very low, and there are also no studies that have investigated incidences of MDRPU. Therefore, there is a need for systematic studies with assured reliability and validity.

In addition to awareness about MDRPU in clinical settings, active evidence-based nursing activities for the prevention of MDRPUs are also needed. For this, the development of strategic protocols at the institutional level, together with quality improvement programmes and customised training programmes for the prevention and treatment of pressure ulcers that correspond to the actual educational needs of medical staff in clinical settings, is needed. Furthermore, it is also necessary to improve the performance of MDRPU prevention activities through the application of prophylactic dressings using a systematic approach for efficient management to emphasise prevention over treatment of pressure ulcer. There is also the need for efforts that can be reflected in the development of health care policies and educational policies for the prevention and treatment of pressure ulcers through the development of safe and effective intervention methods that are most urgently needed in clinical settings in improving the quality of healthcare.

Finally, even though paediatric patients represent a group at high risk of MDRPUs, awareness about this issue in Korea is lacking. Therefore, in addition to the adults

investigated in the present study, paediatric patients, including preterm infants, should be recognised as a special group for which a pressure ulcer prevention strategy needs to be developed through an analysis of the current state of MDRPUs.

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## CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest in relation to this work.

## REFERENCES

1. National Pressure Ulcer Advisory Panel, European Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Alliance. In: Haesler E, ed. *Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline*. Osborne Park, Western Australia, Australia: Cambridge Media; 2014.
2. Hopkins A, Dealey C, Bale S, Defloor T, Worboys F. Patient stories of living with a pressure ulcer. *J Adv Nurs*. 2006;56:345-353.
3. Pittman J, Beeson T, Kitterman J, Lancaster S, Shelly A. Medical device-related hospital-acquired pressure ulcers. *J Wound Ostomy Continence Nurs*. 2015;42:151-144.
4. CM VG, Amlung S, Harrison P, Meyer S. Results of the 2008–2009 International Pressure Ulcer Prevalence™ Survey and a 3-year, acute care, unit-specific analysis. *Ostomy Wound Manage*. 2009;55:39-45.
5. Geyer MJ, Brienza DM, Karg P, Trefler E, Kelsey S. A randomized control trial to evaluate pressure-reducing seat cushions for elderly wheelchair users. *Adv Skin Wound Care*. 2001;14:120-129.
6. Rego MA, Martinez FE. Comparison of two nasal prongs for application of continuous positive airway pressure in neonates. *Pediatr Crit Care Med*. 2002;3:239-243.
7. Kwak HR, Kang J. Pressure ulcer prevalence and risk factors at the time of intensive care unit admission. *KJAN*. 2015;27:347-357.
8. Nam MH, Lim JH. Analysis on the situation of inpatients with pressure ulcer by patient safety indicators. *Journal of Digital Convergence*. 2012;10:197-205.
9. Choi WY, Ju HO. Incidence and associated factors of pressure ulcers in newborns. *Child Health Nurs Res*. 2012;18:177-183.
10. Moreiras-Plaza M. Abdominal wall skin pressure ulcer due to a peritoneal catheter. *Perit Dial Int*. 2010;30:257-258.
11. Apold J, Rydrych D. Preventing device-related pressure ulcers: using data to guide statewide change. *J Nurs Care Qual*. 2012;27:28-34.
12. Black J, Cuddigan J, Walko M, Didier L, Lander M, Kelpe M. Medical device related pressure ulcers in hospitalized patients. *Int Wound J*. 2010;7:358-365.
13. Skillman J, Thomas S. An audit of pressure sores caused by intermittent compression devices used to prevent venous thromboembolism. *J Perioper Pract*. 2011;21:418-420.
14. Black J, Alves P, Brindle CT, et al. Use of wound dressings to enhance prevention of pressure ulcers caused by medical devices. *Int Wound J*. 2015;12:322-327.
15. Willock J, Harris C, Harrison J, Poole C. Identifying the characteristics of children with pressure ulcers. *Nurs Times*. 2005;101:40-43.
16. Lee YJ, Kim JY, KAWOCN. Medical device related hospital related pressure ulcer in Korea. *J Wound Manage Res*. 2015;11:87-91.
17. Schluer AB, Halfens RJ, Schols JGA. Pediatric pressure ulcer prevalence: a multicenter, cross-sectional, point prevalence study in Switzerland. *Ostomy Wound Manage*. 2012;58:18-31.
18. Samaniego IA. A sore spot in pediatrics: risk factors for pressure ulcers. *Paediatr Nurs*. 2003;29:278-282.

19. Yong SC, Chen SJ, Boo NY. Incidence of nasal trauma associated with nasal prong versus nasal mask during continuous positive airway pressure treatment in very low birth weight infants: a randomised control study. *Arch Dis Child Fetal Neonatal Ed.* 2005;90:F480-F483.
20. Demarré L, Vanderwee K, Defloor T, Verhaeghe S, Schoonhoven L, Beeckman D. Pressure ulcers : knowledge and attitude of nurses and nursing assistants in Belgian nursing homes. *J Clin Nurs.* 2012;21:1425-1434.
21. Yang NY, Moon SY. Perceived importance, educational needs, knowledge and performance concerning pressure ulcer care by clinical nurses. *KJAN.* 2009;21:95-104.
22. Strand T, Lindgren M. Knowledge, attitudes and barriers towards prevention of pressure ulcers in intensive care units: a descriptive cross-sectional study. *Intensive Crit Care Nurs.* 2010;26(6):335-342.
23. Kuo C, Wootten CT, Tylor D, Werkhaven J, Huffman K, Goudy S. Prevention of pressure ulcers after pediatric tracheostomy using a Mepilex Ag dressing. *Laryngoscope.* 2013;123:3201-3205.
24. Forni C, Loro L, Tremosini M, et al. Use of polyurethane foam inside plaster casts to prevent the onset of heel sores in the population at risk. A controlled clinical study. *J Clin Nurs.* 2011;20:675-680.
25. Günlemez A, Isken T, Gökalp A, Türker G, Arisoy E. Effect of silicon gel sheeting in nasal injury associated with nasal CPAP in preterm infants. *Indian Pediatr.* 2010;47:265-267.
26. Gorecki C, Nixon J, Madill A, Firth J, Brown JM. What influences the impact of pressure ulcers on health-related quality of life? A qualitative patient-focused exploration of contributory factors. *J Tissue Viability.* 2012; 21:3-12.
27. Schubart J. An e-learning program to prevent pressure ulcers in adults with spinal cord injury: a pre- and post-pilot test among rehabilitation patients following discharge to home. *Ostomy Wound Manage.* 2012; 58(10):38-49.
28. Beeckman D, Clays E, Van Hecke A, Vanderwee K, Schoonhoven L, Verhaeghe S. A multi-faceted tailored strategy to implement an electronic clinical decision support system for pressure ulcer prevention in nursing homes: a two-armed randomized controlled trial. *Int J Nurs Stud.* 2013;50: 475-486.
29. Bales I, Duvendack T. Reaching for the moon: achieving zero pressure ulcer prevalence, an update. *J Wound Care.* 2011;20:374-377.
30. Kwong E, Lau A, Lee R, Kwan R. A pressure ulcer prevention programme specially designed for nursing homes: does it work? *J Clin Nurs.* 2011;20: 2777-2786.
31. Thomas ME. The providers' coordination of care: a model for collaboration across the continuum of care. *Prof Case Manage.* 2008;13:220-227.

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