Risk Management and Healthcare Policy

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ORIGINAL RESEARCH

Analysis of the Current Status of Nurses' Knowledge of Pressure Injuries and Factors Influencing It in Shaanxi Province, China: A Cross-Sectional Study

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Background: Pressure injuries are present in all healthcare environments and not only pose a significant health risk to individuals but also impose a heavy economic burden on society and families. Nurses, as the primary caregivers responsible for the prevention and management of pressure injuries, have knowledge that directly determines the incidence of pressure injuries.

Aim: To understand the current status of nurses' knowledge of pressure injuries in Shaanxi Province and the factors influencing it.

Design: A cross-sectional survey.

Methods: In April - May 2022, 16,599 nurses from hospitals at all levels in Shaanxi Province were selected as survey subjects by convenience sampling method. They were surveyed using the general information questionnaire and the Pieper-Zulkowski pressure injury Knowledge Questionnaire through the Questionnaire Star platform.

Results: 16,599 nurses had a pressure injury knowledge score of (44.32±10.11). Wound description and pressure ulcer staging dimensions were less than 60% correct. Comparison of pressure injury knowledge scores of nursing staff with different genders, hospital levels, titles, education, whether they were specialized nurses in wound stoma when they last attended a lecture on pressure ulcers, when they last read literature or books on pressure ulcers, and whether they ever looked for information about pressure ulcers on the Internet showed that the differences were statistically significant ($P < 0.05$), which were the influencing factors of the knowledge scores of the nursing staff in Shaanxi Province.

Conclusion: Clinical nurses' awareness of stress-related injuries still needs to be improved, and nursing administrators can improve the quality of pressure-related injury care by increasing nursing staff's awareness through continuing education, tiered training, and other measures.

Keywords: pressure injury, knowledge, prevention, management, influencing factor

Introduction

PI is a localized injury to the skin and soft tissues at the bony prominence under medical or other instruments due to intense and prolonged pressure or pressure combined with shear.[1] The International Guidelines for the Clinical Management of Pressure Injuries, 2019 Edition, update the definition of PI as localized injury to the skin and subcutaneous tissues due to the combined action of pressure or pressure combined with shear.[2] A 2020 systematic evaluation showed that the overall prevalence of combined pressure injuries has been as high as 12.8% of 1,366,848 patients globally, with an average incidence of 5.4%, and a hospital-acquired Pressure Injury (Hospital-acquired Pressure Injury (HAPI)) prevalence rate of 8.4%, which is at a high level.[3] In China, the incidence rate of hospital-acquired pressure injuries among inpatients in tertiary hospitals was 0.03% in 2017. The point-in-time survey organized by the National Center for Nursing Quality Control in August 2017 showed that the median point-in-time presenting rate of pressure injuries in tertiary hospitals was 1.00%, of which the median incidence rate of hospital-acquired pressure injuries was 0.10%.[4,5] With direct health economic expenditures for PI prevention and treatment amounting to $25 billion

Received: 8 January 2024
Accepted: 13 May 2024
Published: 31 May 2024

annually, the incidence of PIs as a care indicator for quality regulation is of particular concern in healthcare systems worldwide.[3,6,7] How to actively prevent the occurrence of PIs and provide correct and effective care for those that have occurred has become a key issue in current clinical care.

Clinical nurses, as the first line of defense in pressure injury prevention, can directly influence patient safety/outcomes with their level of knowledge related to PI.[8,9] Despite the fact that domestic and international experts have developed PI nursing guidelines that have been published and pointed out the importance of pressure ulcer prevention, the level of knowledge of clinical nurses about PI still varies. Reviewing the literature, only a few studies showed a more satisfactory level of pressure injury knowledge among nurses. Miller et al investigated the level of pressure injury knowledge related to critical care nurses using the Pieper-Zulkowski pressure ulcer knowledge test questionnaire, and the study showed a gap in the knowledge related to pressure injury practice. The results of the study were as follows. Age, work experience, and other factors significantly affected the results.[10] Grešš Halász et al investigated the knowledge and attitudes of 225 nurses regarding pressure ulcer prevention. The results showed that nurses had insufficient knowledge and attitudes regarding pressure ulcer prevention. There was a significant positive correlation between knowledge and attitude. In addition, education level and department made a significant difference in the results.[11] Li et al used a self-administered eight-item questionnaire to test subjects' knowledge and attitudes toward pressure injury treatment. The test results were low, and attitudes were average.[12] Chen et al showed that nurses had positive attitudes towards pressure injury care, but they lacked knowledge. Comparing the total score of nurses' knowledge of pressure injury care for bedridden patients at different hospital levels, the highest education, titles, and positions showed statistically significant differences.[8] Nurses' knowledge and attitudes towards pressure ulcers are fundamental in practice. While prevention of pressure ulcers is essential, effective wound care is also essential to promoting the improvement of pressure ulcers once they occur. Studies have reported that with effective wound dressing change care, the PI cure rate can increase from 25.81% to 42.25%, and the PI wound improvement rate can be as high as 90% or more, saving 35.23% of the patient's economic expenditure.[13,14] Although it is difficult for nurses to apply some pressure ulcer treatments, nursing staff need to master the staging of pressure ulcers and the various properties of wound dressings in order to intervene accurately to promote wound healing. Fulbrook et al surveyed the level of knowledge of pressure ulcers among nurses at a tertiary care hospital in Australia. They found insufficient knowledge of pressure injuries associated with wound dressings and other relevant pressure injuries.[15] In summary, nurses' knowledge of pressure ulcers needs to be improved, suggesting that nursing administrators should focus their education on this area.

PI is a serious, preventable, and common healthcare problem, which has become a common concern for healthcare organizations, elderly care institutions, and families of bedridden patients around the world due to its rapid progression and long treatment period, which not only brings great pain to patients, but also imposes a huge economic burden on the country, society, healthcare institutions, and families.[16] Clinical nurses, as the main implementers of PI nursing measures, have a direct impact on patient outcomes and quality of life through their mastery of PI-related knowledge and practice skills, but there have been several studies with conflicting findings on nurses' knowledge and practice of PI.[12] Therefore, this study investigated the current status of PI knowledge among nursing staff at all levels of hospitals through the Shaanxi Provincial Quality Control Center and analyzed its influencing factors, with the aim of providing an evidence-based basis for nursing administrators to develop a management plan for patient PI.

Methods

Design

This study utilized a cross-sectional design with an online questionnaire to investigate the level of nurses' pressure injury knowledge in Shaanxi Province.

Participants

In April-May 2022, a convenience sampling method was used to conduct a survey through the Shaanxi Provincial Quality Control Center for nursing staff at all levels of hospitals in Shaanxi Province. We further clarified to the target

population that the inclusion criteria for participants were full-time registered nurses. Students or those undergoing nursing training were not included in the waiting list. All respondents gave informed consent and participated in this study voluntarily.

Survey Tools

The self-administered questionnaire used had two parts: the Pieper-Zulkowski pressure injury Knowledge Questionnaire - Version 2, and the General Information Questionnaire.

Pieper-Zulkowski Pressure Injury Knowledge Questionnaire - 2nd Edition

The Pieper-Zulkowski Pressure Ulcer Knowledge Test (PZ-PUKT) was developed by Pieper and Mott in 1993 and updated by Pieper and Zulkowski in 2014.[17,18] This tool was designed to assess nurses' knowledge of pressure injuries. The questionnaire's content was updated again in 2016 according to the latest clinical practice guidelines and is known as the PZ-PUKT version 2. This questionnaire is widely used for assessment in the United States, Australia, the Philippines, Brazil, and other countries. It is recommended by the international pressure ulcer guidelines of the NPIAP (National et al), EPUAP (European et al), and PPPIA (Pan-Pacific et al).[10,15,19–21] The PZ-PUKT is divided into two parts: the first part consists of 12 items and focuses on collecting social demographic data and essential information on PI knowledge acquisition. The second part is the actual test portion, containing 72 items covering three dimensions: risk factors/prevention, PI staging, and wound description. Wenbo Nie and other scholars completed the Chinese version of the questionnaire in 2020 for Chinese language adaptation. The Chinese version of the PZ-PUKT performed well in internal consistency, and its overall Cronbach α value reached 0.932, showing high reliability. The Cronbachs α values of the dimensions also showed good consistency, namely risk factors/prevention 0.831, PI staging 0.823, and wound description 0.840. These values were slightly higher than those of the original version of the questionnaire, indicating that the Chinese version of the questionnaire is reliable in measuring the nurses' knowledge about PI.[22] In the scoring system of PZ-PUKT, the questionnaire response options were set as "correct", "wrong", and "do not know". One point was awarded for each correct response, and no points were awarded for incorrect and do not know, out of a total of 72 points (Supplementary File 1).

General Information Questionnaire

A general information questionnaire designed by the group itself based on a review of the literature, including: general demographic information such as gender, age, department, title, and working hours.

Data Collection

Between April 1 and May 31, 2022, the principal investigator sent an invitation to recruitment and informed consent via Email to the Shaanxi Provincial Nursing Quality Control Center, contacted the nursing departments of hospitals at all levels in Shaanxi Province and sent the questionnaire in the form of Questionstar (China's most popular social media application), which in turn sent the link to the questionnaire to clinical nurses (https://www.wjx.cn/vm/riulRV4.aspx) and instructions for completion. The questionnaire was anonymized and quality control was performed using the questionnaire star after, each person could only submit 1 time, and the questionnaire was set to be submitted only after all the questionnaires were completed to ensure the completeness and validity of the questionnaire filled out, and the questionnaire was distributed in a timely manner to provide feedback to the core members of the questionnaire collection to ensure the number of people who participated in the survey. After the questionnaires were recovered, the data were checked by 2 researchers and invalid questionnaires were manually eliminated. In the survey, the researcher conducted the questionnaire only after obtaining online consent from the participants.

Ethical Considerations

Prior to data collection, the investigators explained the purpose, process, and potential benefits and risks to the head of the Shaanxi Province Quality Control Center and the respondents. The study complied with the provisions and ethical principles of the 1995 Declaration of Helsinki (revised in Edinburgh in 2000). This study was approved by the Ethics Committee of the First Affiliated Hospital of Xi'an Jiaotong University (No. XJTUIAF2023LSK-305).

Data Analysis

The survey results were exported from the questionnaire star platform to Excel software to establish the original database, and the invalid questionnaires were excluded and imported into SPSS 26.0 software for statistical analysis of the data. Frequency counts and composition ratios described the count data; the measurement data conforming to normal distribution were described by mean ± standard deviation; the potential factors affecting knowledge were determined by one-way analysis (independent samples *t*-test and analysis of variance); multivariate linear analysis was carried out with all the potential factors determined by one-way analysis as the independent variables, and the difference was statistically significant at $P < 0.05$.

Results

General Demographic Characteristics

See Table 1.

Table 1 One-Way Analysis of General Information of Survey Respondents and Caregiver's Knowledge Score on Pressure Injuries (n=16,599)

Sports Event	Number of Persons (n)	Proportion (%)	Pressure Injury Knowledge Questionnaire Score	*t/F* value	P-value
Distinguishing between the sexes					
Male	419	2.52	41.89±11.85	−4.985	<0.001
Daughter	16,180	97.48	44.38±10.06		
Hospital level					
Grade 3A	7714	46.47	44.98±9.82	22.940	<0.001
Grade 3B	491	2.96	47.13±8.10		
Grade C	12	0.07	37.92±11.50		
Grade 2A	7776	46.85	43.38±10.40		
Grade 2B	583	3.51	45.98±10.34		
Grade A	14	0.08	42.36±7.94		
Class A (B)	2	0.01	47.50±6.36		
Grade C	7	0.04	40.86±8.19		
Administrative division					
ICU	964	5.81	45.77±9.57	39.111	<0.001
Emergency department	1022	6.16	43.19±10.17		
Geriatrics	414	2.49	45.87±9.47		
Neurology	1334	8.03	46.15±9.01		
Rehabilitation department	390	2.35	46.24±7.73		
Gynaecology	792	4.77	40.77±12.08		
Neonatology	272	1.64	40.14±11.92		
Neurosurgery	3451	20.79	45.26±9.31		
General medicine	4325	26.06	44.69±9.84		
(sth. or sb) else	3635	21.90	42.96±10.87		

(*Continued*)

Table 1 (Continued).

Sports Event	Number of Persons (n)	Proportion (%)	Pressure Injury Knowledge Questionnaire Score	*t/F* value	P-value
Title					
Physiotherapists	4194	25.27	42.88±10.33	85.611	<0.001
Physiotherapists	7873	47.43	43.92±10.09		
Nurse practitioner-in-charge	4034	24.30	45.96±9.67		
Associate Chief Nurse	479	2.89	49.46±8.62		
Chief Nurse	19	0.11	51.05±8.82		
Working hours					
Less than 1 year	798	4.81	43.01±10.00	32.376	<0.001
1–5 years	4592	27.66	43.88±10.11		
>5 years - <10 years	5026	30.28	43.85±10.30		
10 years - <15 years	3699	22.28	44.32±10.29		
15 years - <20 years	1131	6.81	45.83±9.57		
≥ 20 years	1353	8.15	47.10±8.80		
Highest level of education					
Vocational secondary school	158	0.95	42.76±10.06	33.863	<0.001
Three-year college	5308	31.98	43.07±10.06		
Undergraduate (adjective)	11,098	66.86	44.92±10.08		
Bachelor's degree	32	0.19	50.09±11.19		
Doctoral	3	0.02	41.33±6.03		
Is a wound stoma specialist nurse					
Be	276	1.66	47.86±9.60	−5.867	<0.001
Clogged	16,323	98.34	44.26±10.11		
Date of last lecture on pressure ulcers					
Within 1 year	8461	50.97	46.02±9.16	228.061	<0.001
Greater than 1 year but less than 2 years	3134	18.88	44.73±9.08		
2–3 years	1567	9.44	43.40±9.88		
4 years or more	890	5.36	41.70±10.94		
Never before	2547	15.51	39.63±12.24		
Most recent reading of literature or book on pressure ulcers					
Within 1 year	10,649	64.15	45.65±9.30	232.344	<0.001
Greater than 1 year Less than 2 years	2573	15.50	44.12±9.29		
2–3 years	1154	6.95	42.63±10.22		
4 years or more	990	5.96	41.42±9.99		
Never before	1437	8.66	37.79±13.61		
Ever looked up information about pressure ulcers on the internet					
Be	13,713	82.61	45.14±9.41	23.251	<0.001
Clogged	2886	17.39	40.40±12.21		
Have you read the International Guidelines for the Prevention and Treatment of Pressure Ulcers?					
Be	4864	29.30	46.18±9.36	15.339	<0.001
Clogged	11,735	70.70	43.55±10.31		

Current Status of Nursing Staff's Knowledge Level of Pressure Injuries in Shaanxi Province

Total Pressure Injury Knowledge Score and Dimension Scores

The total PI knowledge score of 16,599 nurses was (44.32±10.11) and the standardized score was calculated according to the highest possible score of 72. 61.56%, Among them, the nursing staff had the highest level of knowledge in the risk

factor/prevention dimension (66.87%) and the lowest level of knowledge in the wound description dimension (56.70%). See Table 2 for details.

Top 10 and Bottom 10 Entries for Pressure Injury Knowledge Scores

The knowledge questionnaire items were analyzed, and the top 10 and bottom 10 scores are shown in Tables 3 and 4. The highest scoring item was "Dragging a patient on the bed increases friction", and the lowest scoring item was "For patients who are immobile but communicative, tell them to change their center of gravity every 30 minutes while sitting in a chair". The highest scoring item was "Dragging the patient in bed increases friction" and the lowest scoring item was "For patients who cannot move but can communicate, tell them to change their center of gravity every 30 minutes while sitting in the chair."

Table 2 Total and Dimensional Scores of the Pressure Injury Knowledge Questionnaire

Sports Event	Entry	Score (Points)	Correctness (%)
Totals	72	44.32±10.11	61.56±14.05
Risk factors/prevention	28	18.72±3.98	66.87±14.23
Pressure ulcer staging	20	11.99±3.46	59.95±16.83
Wound Description	24	13.67±4.04	56.70±21.68

Note: Percentage correct (%) = score / full score x 100%.

Table 3 Top 10 Scoring Entries on the Pressure Injury Knowledge Questionnaire

Entry (in a Dictionary, Encyclopedia etc)	Score ($\bar{x} \pm s$)
15. Dragging the patient in bed increases friction.	0.94±0.239
8. For bedridden patients the position should be changed according to risk factors and the characteristics of the support surface.	0.94±0.246
18. There should be a bowel care plan for incontinent patients.	0.93±0.252
5. Chair cushions should be placed on patients who are wheelchair users.	0.92±0.276
61. The nurse should avoid pressing on reddened skin when the patient is turned.	0.92±0.278
28. Individuals at risk for pressure injuries should have a nutritional assessment (eg, weight, nutritional intake, blood tests).	0.91±0.288
16. Patients who cannot tolerate large positional changes may undergo small positional changes.	0.90±0.297
23. Home care facilities require special consideration of the choice of support surfaces.	0.89±0.317
46. Patients with spinal cord injuries need to know about pressure injury prevention and self-care.	0.89±0.31
58. Selection of appropriately sized devices for obese patients has the potential to avoid pressure injuries.	0.89±0.317

Table 4 Entries with the Bottom 10 Scores on the Pressure Injury Knowledge Questionnaire

Entry (in a Dictionary, Encyclopedia etc)	Score ($\bar{x} \pm s$)
50. Patients who are immobile but can communicate can be told to change their center of gravity position every 30 minutes while sitting in a chair.	0.15±0.362
43. Massage of bony elevations is essential for skin care.	0.17±0.376
10. Pressure injuries progress in a linear fashion from stage I to stages II, III, and IV.	0.18±0.382
25. Loop-shaped pressure-relief devices help prevent pressure damage.	0.21±0.405
Stage 6.3 pressure injuries are those involving partial cortical loss of the epidermis and/or dermis.	0.25±0.436
66. Pressure injuries can be cleaned with potable water.	0.26±0.437
33. Separate employee education and training may reduce the incidence of pressure injuries.	0.27±0.444
53. Support surfaces should be selected only in consideration of the patient's level of risk for pressure injuries.	0.28±0.449
13. The aim of palliative care is wound healing.	0.28±0.451
37.3 Stage 3 pressure injuries may expose bone, tendon, or muscle.	0.29±0.455

Analysis of Factors Influencing the Level of Knowledge of Nursing Staff About Pressure Injuries

One-Way Analysis of Variance

As can be seen in Table 1, general demographic information such as gender, age, hospital level, department, title, and working hours were all factors that influenced the level of nurses' knowledge about pressure injuries (all $p < 0.001$).

Multifactorial Analysis

Multiple linear regression analysis was performed with the total score of the pressure injury knowledge questionnaire as the dependent variable and the factors that were statistically significant in the univariate analysis as the independent variables, and the values assigned to the independent variables are shown in Table 5. The results showed that: gender, hospital level, title, education, whether or not they were nurses specializing in wound ostomy, the time of the most recent seminar they had attended on pressure ulcers, the time of the most recent reading of the literature or books on pressure ulcers, and whether or not they had ever searched on the Internet for information about pressure ulcers were influential factors in the level of knowledge about pressure injuries ($p < 0.05$), see Table 6.

Table 5 Assignment of Independent Variables

Variant	Assign a Value to Something
Distinguishing between the sexes	1=Male; 2=Female
Hospital level	1=Triple A; 2=Triple B; 3=Triple C; 4=Di A; 5=Di B; 6=Di C; 7=1 A; 8=1 B; 9=1 C
Unit (eg intensive care unit)	Setting dummy variables to "ICU" as reference
Title	1=Nurse; 2=Nurse Practitioner; 3=Nurse Practitioner-in-Charge; 4=Associate Nurse Practitioner; 5=Chief Nurse Practitioner
Working hours	1 = <1 year; 2 = 1 to 5 years; 3 = >5 to 10 years; 4 = 10 to <15 years; 5 = 15 to <20 years; 6 = ≥20 years
Highest level of education	1=Secondary; 2=College; 3=Bachelor's degree; 4=Master's degree; 5=Doctoral degree
Is a wound stoma specialist nurse	1=Yes; 2=No
Date of last lecture on pressure ulcers	1 = <1 year; 2 = 1 to 2 years; 3 = 2 to 3 years; 4 = >4 years; 5 = never
Most recent reading of literature or book on pressure ulcers	1 = <1 year; 2 = 1 to 2 years; 3 = 2 to 3 years; 4 = >4 years; 5 = never
Ever looked up information about pressure ulcers on the internet	1=Yes; 2=No
Have you read the International Guidelines for the Prevention and Treatment of Pressure Ulcers?	1=Yes; 2=No
Pressure Injury Knowledge Questionnaire Score	Original value carried over

Table 6 Multiple Linear Regression Analysis of Factors Influencing Nurses' Level of Knowledge About Stress Injuries

Mould	Unstandardized Coefficient		Standardized Coefficient	t	P
	B	Standard Error	Beta		
(Constant)	41.931	0.532	–	78.822	<0.001
Distinguishing between the sexes	−1.777	0.478	−0.028	−3.715	<0.001
Hospital level	−0.163	0.051	−0.025	−3.215	0.001
Title	1.631	0.100	0.127	16.312	<0.001
Highest Level of education	0.452	0.162	0.022	2.801	0.005
Is a wound stoma specialist nurse	1.638	0.583	0.021	2.810	0.005
Date of last lecture on pressure ulcers	−0.865	0.059	−0.126	−14.627	<0.001
Most recent reading of literature or book on pressure ulcers	−0.894	0.070	−0.113	−12.753	<0.001
Ever looked up information about pressure ulcers on the internet	2.631	0.210	0.099	12.511	<0.001

(*Continued*)

Table 6 (Continued).

Mould	Unstandardized Coefficient		Standardized Coefficient	t	P
	B	Standard Error	Beta		
Have you read the International Guidelines for the Prevention and Treatment of Pressure Ulcers?	0.743	0.172	0.033	4.324	<0.001
Administrative division*					
Emergency department	−1.402	0.314	−0.033	−4.469	<0.001
Gynaecology	−3.137	0.354	−0.066	−8.867	<0.001
Neonatology	−4.040	0.587	−0.051	−6.885	<0.001
(sth. or sb) else	−1.628	0.186	−0.067	−8.763	<0.001

Notes: *Using ICU as reference; R^2 = 0.112, R^2_{adj} = 0.112, F = 161.337, p < 0.001; "–" means no such data; only statistically significant variables are presented.

Discussion

This cross-sectional survey was designed to determine nurses' knowledge of pressure ulcers in hospitals in Shaanxi Province. The results showed that 16,599 nursing staff had a correct knowledge of PI of 61.59%, and by reviewing the results of previous surveys, it was possible to obtain a total score of roughly 64.9% to 80.0% for the standardized score of the PZ-PUKT.[10,15,18,22] The results of this study show that nurses' knowledge scores for PI were relatively low, especially for the staging of pressure wounds (59.95%). The description of wounds (56.70%) dimensions scored significantly lower than the risk factor/prevention dimension (66.87%), consistent with the results of the study by Nie et al,[22] suggesting that nurses' knowledge of this domain is not optimistic. In addition, this survey also found that nurses had a low rate of correctly identifying PIs of stage 2 and above and analyzed the reasons: this may be related to the fact that the knowledge of PIs needs to be emphasized by managers in clinical work.[23–25] Therefore, we remind managers to strengthen the training of PIs, and especially emphasize the training of clinical nurses in the staging and diagnosis of PIs. The dimension of "wound description" scored the lowest. Although a revised version of the scale was used in this study, previous studies have reported that it is the weakest area of knowledge.[26] This suggests that nursing staff's knowledge of pressure injuries is not sufficiently comprehensive and refined, which may be related to general nurses' lack of practical experience in managing PI wounds or less training in related practices. Once a PI occurs, specialized wound specialist nurses take on the work of consultation and management of difficult PIs, thus reducing the opportunity for clinical nursing staff to deal with PIs, coupled with the increasingly heavy workload of clinical nursing, some general nurses believe that their knowledge of PIs is sufficient to cope with the clinical PI situation, and they do not have sufficient knowledge of the dressings used for dressing changes of PI wounds and of the techniques of cleansing and debridement, which is also the reason for the lack of knowledge of PIs among the general nurses in the present study. One reason wound specialist nurses generally had higher levels of PI knowledge than general nurses is that Wound, Ostomy, and continence nurse (WOCN) is fundamental to the development of quality wound care services.[27] However, it was found that only 276 (1.66%) held a wound care specialist qualification. Due to the limited annual enrollment quotas in training schools, long training cycles, high costs, and strict entry requirements, clinical nurses in remote areas or primary hospitals are disqualified from training. Thus, wound specialist nurses are concentrated in tertiary hospitals, resulting in geographic imbalance and insufficient training of general registered nurses in this field.[28,29] It suggests that emphasis should be placed on wound care speciality training for primary clinical nurses, combining various forms of training such as demonstration teaching, experience exchange, role-playing, watching videos, nursing check-ups, and special lectures to improve individual knowledge, thus comprehensively improving the level of clinical speciality care. From the analysis of the study results, the lowest-scoring entry was "For patients who cannot move but can communicate, tell them to change their center of gravity every 30 minutes while sitting in a chair", indicating that most caregivers did not consider personalized factors when setting the time for changing positions; the entry "Massage of bony elevations is essential for skin care" had the second highest response error rate, and the correct practice is not to massage or scrub hard on skin at risk of PI, which are all covered in the guidelines. Meanwhile, the results of Table 1 show that only 29.30% of nursing staff have read the international guidelines for the prevention and treatment of PI, which

indicates that the learning of guidelines by nursing staff is not optimistic, so nursing managers should be targeted to strengthen the knowledge related to the poor mastery of entries, and organize nursing staff to learn the relevant guidelines for the prevention and management of PI, and carry out quality improvement projects to bridge the gap between the theory and practice of PI.

In our study, higher title and education were associated with higher levels of PI knowledge, which is consistent with the findings of Al-Shidi and Li et al[26,30] The reasons for this were analyzed as follows: ① Higher-educated nurses are more capable of independent learning, and undergraduate education and above have evidence-based nursing courses, so they have better evidence-based literacy and information retrieval skills, and are able to take the initiative to review domestic and international literature to understand the evidence related to the preventive management of PIs; ② Nurses with higher titles have rich clinical experience and have encountered more cases of PIs, which leads to an accumulation of relevant nursing insights in their practice; furthermore, higher-titled nurses In addition, nurses with higher titles have more opportunities to participate in in-hospital and out-of-hospital training and academic exchanges, and their basic knowledge of wound care is significantly higher than that of nurses with lower titles. There is still a lack of research on the difference in the level of PI knowledge of nurses in different departments. The results of this survey showed that the PI knowledge scores of wound stoma specialist nurses were much higher than those of general nurses, probably because specialist nurses had passed the wound care practitioner qualification examination, participated in difficult wound consultation and management in various departments, and had relatively higher professional theory and practice qualities. It is suggested that nursing managers should focus on strengthening the knowledge training of low-education, low-middle title and non-specialized nurses, integrating the educational content of PI prevention and management into the training curriculum of new nurses, and using specialized nurses as the leading role and the Hospital Wound Ostomy Nursing Group as the platform to drive the cooperation and learning among departments. In addition, this survey showed that gender, hospital level and department were the influencing factors of nurses' PI knowledge level, and female nurses' knowledge scores were higher than those of males, which might be related to the small proportion of male nurses in the sample size. In the future, it is necessary to balance the proportion of male and female samples to analyze further the relationship between gender characteristics and PI knowledge scores. Overall, the nurses' knowledge level for PI was ranked as tertiary hospitals > secondary hospitals > primary hospitals, which is consistent with the results of Chen Changrong's study.[31] The main reason for this is that the overall quality and professional ability of nurses in tertiary hospitals are better than those in primary hospitals, such as secondary hospitals, and tertiary hospitals pay more attention to the level of speciality care. Although the department is also an influential factor on the knowledge level of PI through univariate analysis, we found that other departments, such as the emergency department, paediatrics and neonatology, were the main influential factors through the dummy variable setting with "ICU" as the reference, which may be related to the fact that the emergency department and paediatrics are the departments with a high prevalence of PI and that nurses in these departments pay more attention to PI in order to reduce the occurrence of adverse nursing events. In order to reduce the occurrence of adverse nursing events, nurses in the above departments are more concerned about PI.

We also found that the time of the most recent lecture on pressure ulcers, the most recent time of reading literature or books on pressure ulcers, and whether or not they had looked up information about pressure ulcers on the Internet were influential factors on the level of PI knowledge, which is consistent with the results of several domestic and international scholars that educational programs and self-study have the potential to positively influence nurses' knowledge related to the prevention of pressure ulcers.[10,26,32,33] However, PI education in general wound care curricula is fragmented and lacks consistent learning objectives and content.[34] Professional and systematic training programs are imperative. Continuing education training on PI-related knowledge can improve nurses' knowledge of PI care to a certain extent.[9] Hu et al found that[35] after PI training for clinical nurses through theoretical lectures and practical exercises, case sharing and real-time guidance, clinical nurses' mastery of PI-specific nursing skills and theoretical knowledge improved significantly, and they were able to actively participate in the PI nursing process, with a significant improvement in PI protective behaviors. A systematic evaluation of chronic wound management education showed that nurses' wound care competence could be improved through digital training and blended teaching methods.[36] With the help of information technology, not only can we overcome the dilemma of nurses being unable to participate in on-site training due to busy work schedules, but also helps to enrich the teaching content and simulate diversified real-life cases, which can

effectively improve the effect of nurse PI training. Therefore, administrators should construct a specialized and multi-dimensional PI curriculum system and be brave enough to change teaching strategies to promote the sustainable development of PI nursing education.

Limitations

There are certain limitations in this study. First, the study population came from hospitals at all levels in Shaanxi Province, and some of the conclusions may not be generalizable to medical institutions in other provinces and countries; second, if the questionnaire was self-assessed, there may be some memory bias and exaggeration, which lacks a certain degree of objectivity; third, this study lacked an exploration of the objective factors, such as time, staffing, patients, the hospital environment, and culture; and fourth, the influencing factors identified in the present study could only explain 10.13% of the total variation in PI knowledge level, and more variables need to be included in the future to further analyze the influencing factors of nurses' PI knowledge level.

Conclusion

The results of this study showed that the average score rate of the questionnaire on pressure injury knowledge of clinical nurses in Shaanxi Province was 61.56%, and their knowledge level needs to be improved. Gender, hospital level, title, education, whether or not they are specialized nurses in wound stoma, the last time they attended a lecture on pressure ulcers, the last time they read literature or books on pressure ulcers, and whether or not they had looked up information about pressure ulcers on the Internet were the influencing factors for the level of knowledge about pressure injuries ($P < 0.05$). In addition, wound description and pressure ulcer staging scores were all <60% correct. It is suggested that managers should construct a specialized and multidimensional PI curriculum system, focusing on strengthening training in the areas of wound dressings, pressure ulcer staging, seated posture and seated support surfaces, as well as the need for further research to determine the appropriate repositioning timeframes for seated individuals, constructing a standardized PI nursing process based on evidence, and giving targeted training in the prevention and management of PIs based on the characteristics of different nurses and their individualized learning needs. By strengthening knowledge and establishing positive attitudes, nursing behavioural changes can be driven to improve nurses' PI nursing knowledge and skills and narrow the gap between theory and practice.

Ethical Approval and Informed Consent

The study was approved by the Ethics Committee of the First Affiliated Hospital of Xi'an Jiaotong University (No. XJTUIAF2023LSK-305). Nurses gave online informed consent before the survey and were able to withdraw from the survey at any time.

Funding

This study was supported by the National Health and Wellness Commission Hospital Quality of Care (Evidence-Based) Management Research Program (YLZLXZ23G073).

Disclosure

The authors report no conflicts of interest in this work.

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